Policies & Measures and Projections of Greenhouse Gas Emissions in Lithuania

Report pursuant to Articles 18 and 39 of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action and pursuant to Articles 36, 37 and 38 of Implementing regulation (EU) 2020/1208

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Preface

The Lithuania's policies and measures and greenhouse gas (hereinafter – GHG) emissions projections submission is prepared pursuant to Articles 18 and 39 of the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action. The submission contains:

- ✓ Policies & Measures and Projections of GHG Emissions in Lithuania technical report.
- ✓ Templates for reporting under Article 38 of the related Implementing Regulation (EU) 2020/1208.

CONTENT

ABBREVIATIONS

BY	Base year
CHP	Combined Heat and Power
EC	European Commission
EF	Emission Factor
EPA	Environmental Protection Agency
ESD	Effort Sharing Decision
ESR	Effort Sharing Regulation
ETS	Emission Trading System
EU	European Union
EUA	European Union emission trading allowances
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
JSC	Joint Stock Company
LULUCF	Land Use, Land-Use Change and Forestry
MoA	Ministry of Agriculture
MMS	Manure Management System
MSW	Municipal Solid Waste
NECP	National Energy and Climate Plan
NEIS	National Energy Independence Strategy
NGOs	Non-governmental organizations
NID	National Inventory Document
NMVOC	Non-methane volatile organic compounds
NPP	Nuclear Power Plant
Non-ETS	non-ETS sectors
PaMs	Policies and Measures
PP	Power Plant
QA/QC	Quality Assurance and Quality Control
RDP	Rural Development Program
RES	Renewable Energy Sources
SAPS	Single Area Payment Scheme
SDG	Sustainable Development Goals
SFI	State Forest Inventory
SFS	State Forest Service
SMEs	Small and medium enterprises
SPD	Single Programming Document
SWDS	Solid Waste Disposal Sites
UNFCCC	United Nations Framework Convention on Climate Change

WAM	Scenario with additional measures
WEM	Scenario with existing measures
WOM	Scenario without measures
WW	Wastewater

CHEMICAL FORMULAS

CH_4	Methane
CO_2	Carbon dioxide
HFCs	Hydrofluorocarbons
N	Nitrogen
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
NOx	Nitrogen oxides
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
VOC	Volatile organic compounds

UNITS OF MEASUREMENT

CO_2 *eq.*	CO_2 equivalent
^oC	Degree Celsius
EUR	Euro
GWh	Gigawatt hour
ha	Hectare
kg	Kilograms
km^2	Square kilometres
kt	Kilotonnes
ktoe	Kilotonne of oil equivalent
Mill.	Million
Mt	Million tonnes
MW	Megawatt
%	Per cent
PJ	Petajoule
thous.	Thousand
toe	Tonnes of oil equivalent
TJ	Terajoule
TWh	Terawatt hour

INTRODUCTION

Climate change is one of the major threats and challenges of our time. The climate change issues are particularly worrying as Lithuania is already facing increased intensity and frequency of extreme weather events (heat waves, storms, and floods), leading to reduced crop yields, loss of biodiversity, impact on economy and human health. We understand that without urgent ambitious mitigation actions globally, in the future – it will be more difficult and costly. That's the reason why Lithuania is making efforts to respond to the impacts of climate change and has already taken significant action on mitigation and adaptation.

Lithuania signed and ratified the Paris Agreement in 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States took a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, by implementing the EU legal acts for the EU climate and energy policy targets till 2030, mainly through the EU Emission trading system (EU ETS) and Efforts Sharing Regulation (ESR), as well as Clean Energy Package legislation amounting to 43% and 30% respectively by 2030 compared to 2005.

Based on the European Green Deal strategy and the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition ("2030 Climate Target Plan") the EU has increased the European Union's binding target for 2030 towards at least 55% net emission reduction (compared with 1990 levels). The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 62% in the sectors covered by in the EU emission trading system (EU ETS) and at least 40% in non-ETS sectors by 2030 compared to 2005.

As a member of the European Union, Lithuania is obliged from 2021, to report to the European Commission in accordance is structured under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action and its Implementing Regulation (EU) 2020/1208 to report on national systems for policies and measures and projections, and on policies and measures and projections.

In this technical report we report information on their national systems for policies and measures and projections under Article 39 of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 36, Annex XXIII of the related Implementing Regulation (EU) 2020/1208. Additional, information on GHG policies and measures (PaMs) in accordance with Article 18 (1) (a), Annex VI of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 37, Annex XXIV of the related Implementing Regulation (EU) 2020/1208. And finally, to report GHG projections in accordance with Article 18 (1) (b) of the Governance of the Energy Union and Climate Action Regulation (EU) 2018/1999 and Article 38 of the related Implementing Regulation (EU) 2020/1208.

The report is based on available information, existing plans and strategies of the Lithuania regarding mitigation of climate change and its separate economic sectors.

1. INFORMATION ON NATIONAL SYSTEMS FOR POLICIES AND MEASURES AND PROJECTIONS

The data flows and PaMs and projections reporting system are enshrined in the provisions of the following documents:

1. The Order No D1-64 of the Minister of Environment of 2nd of February 2021 "On Establishment of the National Greenhouse Gas Inventory, Projections, Adaptation to Climate Change, Implementation of Strategy Papers, Collection of Data on Financing of Climate Change Measures, Preparation of Reports and Information System" (repealed the Order of the Minister of Environment No D1-61, 23-01-2014);

2. The Law on Climate Change Management No XI-329 adopted on 07-07-2009 (with the latest update on 15 of July 2024);

3. The Government Resolution No 388 on 7 of April 2004 (with the latest update on 1st of January 2021) "Approval of the description of the procedure for the preparation and submission of information and reports on the implementation of European Union environmental legislation to the European Commission, the European Chemicals Agency and the European Environment Agency".

4. The Government Resolution No 1443 on 4 of November 2009 (with the latest update on 14 of August 2024) "On the delegation of authority for the implementation of the law on climate change management of the republic of Lithuania".

5. The Government Resolution No 1069 on 11 of December 2024 "On the Approval of the National Energy and Climate Action Plan 2021–2030".

The procedure has not been changed since the last PaMs report. The main institutions (see Figure 1-1) involved in the preparation of the PaMs and GHG emission projections and responsible for the process of submission are:

- Ministry of Environment;
- Environmental Protection Agency;
- Lithuanian Energy Agency;
- State Forest Service;
- Data providers.

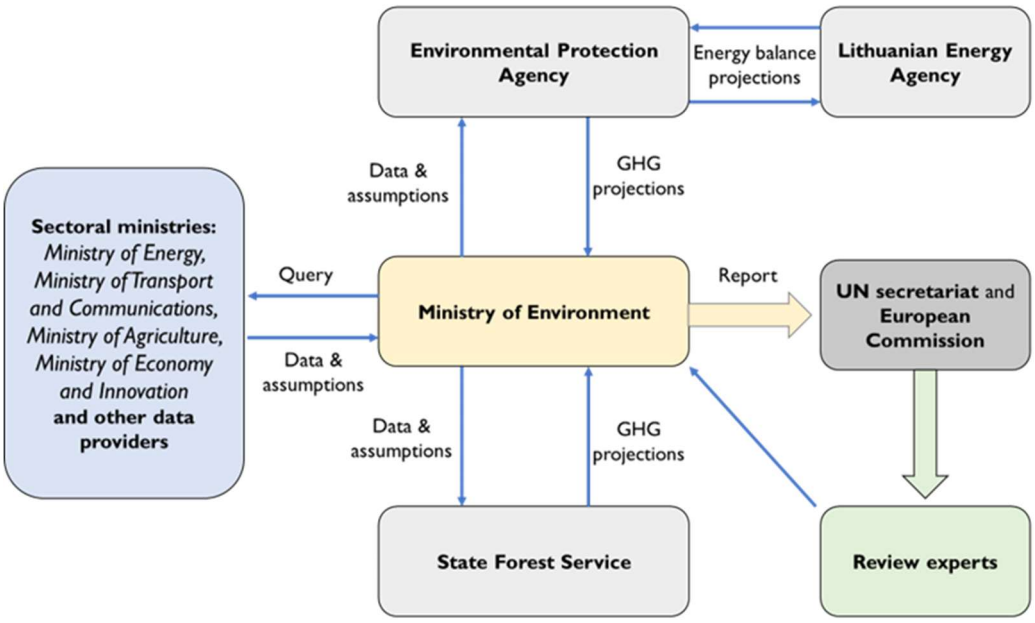

Figure 1-1. The scheme of the main responsible institutions involved in the preparation of PaMs and GHG emission projections report in Lithuania

Ministry of Environment

The Ministry of Environment of the Republic of Lithuania is the main responsible and coordinating institution for developing climate change policy and its implementation in Lithuania. It has overall responsibility for the national system of GHG inventory preparation and PaMs and GHG projections reporting. It is in charge of the legal, institutional and procedural arrangements for the national system and further strategic development.

In 2008 the Climate Change Division was established in the Ministry of Environment and in 2019 was reorganized to the Climate Policy Group.

Among other tasks, the Climate Policy Group responsibilities are the following:

– Preparation of legal acts required for the functioning of the national system;
– Coordination of the preparation of the National GHG Inventory Document;
– Overall coordination of PaMs and GHG projections preparation process between the Environmental Protection Agency, the Lithuanian Energy Agency and the State Forest Service;
– Collection of information from data providers on the currently adopted or planned PaMs in different sectors and preparation of the final report;
– An official consideration, Quality Assurance and Quality Control (QA/QC) and approval of the GHG emission projections report;
– Timely submission of the PaMs and GHG emission projections reports to the European Commission;
– Coordination of the process in Lithuania during the QA procedure of the European Environmental Agency;
– Keeping of archive and publication of the official submissions to the European Commission;
– Preparation of National energy and climate action plan (NECP) – Decarbonization: GHG emissions and removals part.

– Informing other responsible institutions on the preparation process of PaMs and GHG emission projections and relevant national system requirements.

Environmental Protection Agency

The Lithuanian Environmental Protection Agency (EPA) under the Ministry of Environment starting from 2011 was nominated as an entity responsible for GHG inventory and GHG projections preparation by the Order of the Minister of Environment No D1-1017 (repealed by the Order of the Minister of Environment No D1-64, 01-02-2021). Since 2013 the EPA is responsible for calculation of GHG emissions projections based on activity data received from data providers and the preparation of part on GHG emission projections of the report for energy, including transport, industrial processes and product use, agriculture and waste sectors.

The EPA has the following functions and responsibilities:

– Analysis of key categories and identification of specific information, activity data and emission factors used to calculate GHG emission projections;
– Analysis of activity data received from data providers, preparation of assumptions and calculation of GHG projections;
– Performing the sensitivity analysis of GHG projections;
– Filling the reporting on projections template and providing it to the Ministry of Environment;
– Archiving the supplied and used activity data for GHG projections calculations, calculation files of GHG projections and used materials;
– Evaluating requirements for recent activity data, based on internal and external reviews;
– Implementation of initial QC procedures for GHG projections estimates.

State Forest Service

The State Forest Service (SFS) compiles the National Forest Inventory (NFI) and the forest information system, carries out monitoring of the status of the Lithuanian forests, collects and manages forestry statistical data etc. The SFS functions are under the Ministry of Environment. Starting from 2010 in the GHG inventory preparation process SFS is responsible for calculations of emissions and removals in LULUCF sector. Since 2013 under the Order of the Minister of Environment No D1-1017 (repealed by the Order of the Minister of Environment No D1-64, 01-02-2021) the SFS has started to estimate the GHG emission projections for LULUCF sector. These estimates are provided directly to EPA for the compilation of GHG emission projections report.

Data providers

Aiming to set up the system to ensure better data collection for preparing the National GHG inventory document and report on PaMs and GHG emission projections as it was stated above, the amendment of the Government Resolution No 388 of 7 April 2004 was adopted in 2020. The Ministry of Environment requests the data from data providers on adopted and planned PaMs from the responsible ministries and other institutions obliged to provide information according to the Government Resolution. The Figure 1-2 below presents sectoral data providers.

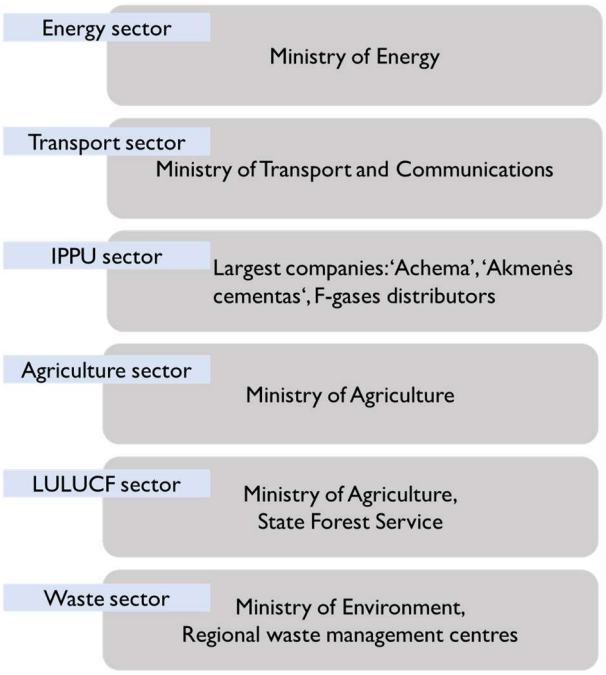

Figure 1-2. Scheme illustrating data flow and activity data providers for the preparation of GHG emission projections

The main data providers are:

- The Lithuanian Energy Agency (LEA) provides the projected fuel consumption trends.
- The Ministry of Energy identifies the main measures related with mitigation of GHG emissions in energy sector.
- The Lithuanian Geological Survey provides data on projected oil production.
- The natural gas transmission enterprise JSC "Amber grid" provides data on forecast of natural gas leakages.
- Average kilometrages of transport vehicles were obtained from Lithuanian Association of Technical Inspection Companies "Transeksta".
- JSC "Lietuvos geležinkeliai" provides the required activity data for the estimation of projections in the railway sub-sector.
- The Ministry of Transport and Communications provides the activity data (fuel consumption) for the estimation of projections in the civil aviation sub-sector.
- The Ministry of Agriculture provides information on the projected livestock population and N fertilizer consumption based on the projected agriculture sector economic development. The main measures related with mitigation of GHG emissions in agriculture sector is identified by the Ministry of Agriculture.
- The largest Lithuania's industrial companies provide information on their planned production capacities.
- The Ministry of the Economy and Innovation identifies the main measures related with mitigation of GHG emissions in the industrial processes and product use sector.
- The Waste Policy Group and Pollution Prevention Policy Group of the Ministry of Environment provide information on the waste sector, wastewater and sludge treatment development and strategic plans. The additional projected data on waste management was collected from the EPA and the Regional Waste Management Centres.

Since 2019 preparation of PaMs/projections reports is closely linking with the preparation of NECP reports pursuant to Art. 17 of Regulation (EU) 2018/1999. The update of the NECP is an important part of the implementation of the international climate change objectives set out in the Paris Agreement and the EU climate change and energy policy mitigation (GHG reduction) targets and objectives until 2030.

In 2022 evaluation of NECP measures was carried out. To achieve high quality result of NECP update, the Ministry of Environment has set up 5 sectoral decarbonisation working groups, where representatives of business, science and NGOs gave suggestions on GHG reduction measures. The Ministry of Environment, sectorial ministries, the EPA experts and consultants of the Ministry of Environment reviewed the proposed measures based on the sectorial objectives, development trends, economic and social aspects. The EPA experts re-evaluated the final list of PaMs. This list is in updated NECP and used for the current submission of the PaMs/projections report.

The NECP was updated in the following order:

− Review and discussion of existing decarbonisation measures from NECP adopted in 2019 (2022 Q I);

− Collection and discussions of new alternative/additional decarbonisation measures in decarbonisation working groups (2022 Q I-II);

− Evaluation of all decarbonisation measures (technical potential, public investment needs, GHG reduction effectiveness, impact on labour market, air pollution, social indicators) (2022 Q II-IV);

− Modelling of the GHG impacts of the updated list of decarbonisation measures (alignment with OECD proposals) (2022 Q IV–2023 Q I);

− Preparation of updated draft NECP (2023 Q II);

− Public and regional consultations (2023 Q III-IV);

− Approval of the updated draft NECP by the Government of the Republic of Lithuania and submissions to the European Commission (2023 Q III);

− Revision of the updated draft NECP based on comments from public consultation, European Commission and changes from sectorial ministries (2023 Q III – 2024 Q II);

− Public consultation (2024 Q III);

− Final version of NECP was adopted and submitted to EC on 3rd October 2024.

2. POLICY AND MEASURES

2.1. General climate policy framework

The Lithuanian climate change policy is developed in line with the targets and objectives laid down in the international agreements under the United Nations Framework Convention on Climate Change (UNFCCC), the EU strategic documents and legislation. The main goals of climate policy are to ensure Lithuania's contribution to climate change mitigation, ensure a balance of environmental, social and economic interests and promote Lithuania's ability to adapt to climate change and its impacts.

In accordance with the **Kyoto Protocol**, Lithuania has undertaken to reduce its GHG emissions by 8% below the 1990 level during the first commitment period 2008–2012 and successfully implemented achieving 56% GHG reduction.

Furthermore, in 2012 at the Doha Climate Change Conference Lithuania – a Party of the Convention and Kyoto Protocol – together with the other EU Member States and Island, undertook a 20% GHG emissions reduction below 1990 level commitment for the second Kyoto Protocol period from 2013 to 2020. It is therefore a joint pledge with no separate targets for Member States under the Convention. **The Doha Amendment of the Kyoto** Protocol was ratified by the Parliament (Seimas) on 20 October 2015.

The target implemented internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision.

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States, the United Kingdom and Island have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO_2 eq.

At the Paris Climate Conference (COP21) in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal. **Paris Agreement** sets out a global action plan to put the world on track to avoid climate change by limiting global warming to well below 2°C above pre-industrial levels and purse efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

Lithuania signed the Paris Agreement on 22 April 2016 and ratified on 30 December 2016. Under the Paris Agreement Lithuania jointly with the EU and its Member States undertook a binding target of at least a 40% domestic reduction in economy wide GHG emissions by 2030 compared to 1990, which was endorsed in the conclusions of the European Council of 23 and 24 October 2014 on the EU 2030 climate and energy policy framework. On 6 March 2015, the Council adopted this contribution of the Union and its Member States as their intended nationally determined contribution, which was submitted to the Secretariat of the UNFCCC. The target is delivered implementing the EU

legal acts on 2030 climate and energy targets by all economy sectors, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% respectively by 2030 compared to 2005.

Based on the European Green Deal strategy and the Commission's Communication of September 2020 on Stepping up Europe's 2030 climate ambition ("2030 Climate Target Plan") the EU has increased the European Union's binding target for 2030 towards at least 55% net emission reduction (compared with 1990 levels). The European Climate Law, adopted in 2021 sets the legally binding EU's climate neutrality target at the latest by 2050, and a binding Union domestic reduction target of at least 55% net emission reduction by 2030 compared to 1990. In order to follow the pathway proposed in the European Climate Law, and deliver this increased level of ambition for 2030, the European Commission has proposed a number of legislative proposals under the "Fit for 55" package laying down obligation to achieve the EU targets of reducing GHG emissions by 62% in the sectors covered by in the EU emission trading system (EU ETS) and at least 40% in non-ETS sectors by 2030 compared to 2005 (see Figure 2-1 below).

Lithuania contributes to the achievement of EU climate targets for 2030. This target is divided into sub-targets for sectors covered by the EU ETS, sectors covered by the EU Effort sharing Regulation[1] (ESR) and the LULUCF sector. ESR sectors are those not covered by the EU ETS. The binding targets on Member State level have only been set for the ESR and LULUCF sectors.

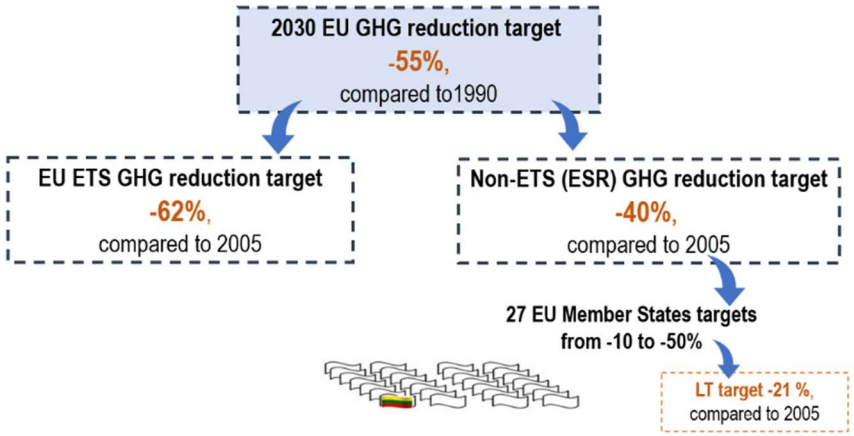

Figure 2-1. EU and it's Member States' targets 2030

Under the revised **EU ETS Directive**[2], a single ETS cap covers the EU Member States and other participating non-EU countries (Norway, Iceland and Liechtenstein, as well as Northern Ireland for electricity generation), and there are no further individual caps for Lithuania. The revisions, most of which came into effect on 1 January 2024, focused on:

- tightening the EU ETS cap to bring down emissions by 62% compared with 2005 levels by 2030;
- including emissions from maritime transport in the system;
- reducing and eliminating free allocation in the manufacturing industry and aviation;

[1] Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 https://eur-lex.europa.eu/eli/reg/2018/842/oj

[2] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02003L0087-20240301

- strengthening the Market Stability Reserve;
- introducing a new Emissions trading system (ETS2) for buildings, road transport and other sectors from 2027) etc.

EU Effort sharing legislation. For sectors outside the scope of the EU ETS and the LULUCF Regulation, binding annual GHG emission targets have been set for the EU Member States. These sectors, which include transport, buildings, agriculture, non-ETS industries and waste, account for almost 60% of total domestic EU emissions. In Lithuania ESR sector accounts 73% of total GHG emissions in 2022. In addition to the EU Member States, Iceland and Norway have agreed to implement the ESR and to commit to binding annual emission allocations for 2021 to 2030.

For the period up to 2020, the Effort Sharing Decision[3] (ESD) set a reduction target of around 10% relative to 2005 levels by 2020 for total EU emissions from the sectors covered by the legislation. National targets under the ESD ranged from -20% to +20% below 2005 emissions. In 2020, the EU's emissions in the effort-sharing sectors were 16.3% lower than in 2005 meaning that the EU overachieved its 2020 ESD target by 6 percentage points. Lithuania as a Member State with a positive limit under ESD over the years 2013–2020 was in compliance with annual emission allocation targets as there was no shortage of the annual emission allocation units during whole commitment period, except for year 2017 (the shortage of units in that year was covered with the banked surplus from previous years).

The Effort Sharing Regulation (ESR), which covers the period up to 2030, was originally adopted in 2018 and revised in 2023. The revision was adopted as part of a package of proposals aimed at reducing the EU's emissions by 55% by 2030 (compared to 1990 levels) and deliver the European Green Deal. As a result, the effort sharing sectors are required to collectively contribute to a 40% reduction in GHG emissions at EU level by 2030, with Member States' targets ranging from -10% to -50% below 2005 levels. The GHG emission reduction target for ESR sectors in Lithuania is a reduction of GHG emissions by 21% in 2030 compared to 2005.

In addition to establishing targets for the reduction of emissions in the Member States by 2030, the ESR also defines annual emission (AEAs) limits for the years 2021 to 2030. For that purpose, Member States are provided with a number of emission allocations (each corresponding to a tonne of CO_2 eq.) for each of the years in the period, and the number of allowances decreases every year. The Commission Implementing Decision (EU) 2020/2126[4] provides each Member State's corresponding number of AEAs for each year from 2021 to 2030.

The ESR maintained most of the flexibilities introduced by the ESD (banking of surpluses with certain banking limits, borrowing of AEAs from the following year, buying and selling AEAs allocations from and to other Member States. Additionally, from 2021 to 2030 Member States are allowed to use credits from LULUCF sector to comply with their national ESR targets.

[3] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009D0406

[4] Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02020D2126-20240731

The LULUCF Regulation[5], originally published in 2018, was amended in 2023 to introduce an EU-wide net carbon removal target of 310 million tonnes of CO_2 eq. by 2030. From 2021 to 2025, countries have to adhere to the "no debit" rule, meaning that accounted emissions from specific managed land categories must be entirely compensated by corresponding accounted CO_2 removals. In contrast, from 2026 to 2030, Member States will have to reach binding national LULUCF targets to contribute to the EU-wide target for 2030. The national target for Lithuania in the LULUCF sector is a net removal of 0.661 Mt CO_2 eq. in 2030 compared to the average GHG net emissions in 2016, 2017 and 2018.

In order to ensure the implementation in the international agreements and the EU legal acts defined targets for Lithuania, on 30 June 2021 by the Decree No XIV-490 of the Parliament of the Republic of Lithuania approved the **National Climate Change Management Agenda** (NCCMA) which lays down the targets and objectives for climate change mitigation and adaptation by 2050. The goal of the NCCMA is to develop and implement climate change management policy in Lithuania. The Agenda sets the short-term (until 2030), mid-term (until 2040) and long-term (until 2050) targets and objectives in the field of climate change mitigation and adaptation.

The national climate change mitigation targets by 2030 are as follows:

- to reduce GHG emissions by 30% compared to 2005 (including LULUCF) by shifting economic sectors towards innovative, low-emission and environmentally friendly technologies and the use of RES;
- for ETS sectors to reduce GHG emissions at least 50% compared to 2005;
- for non-ETS sectors (transport, industry, agriculture, waste, small-scale energy sector), to reduce GHG emissions at least 25% compared to 2005 (including LULUCF) and not exceed the annual emission allocations set for the period 2021–2030 by EU Effort Sharing Regulation.

The national climate change mitigation target by 2040 is to reduce GHG emissions by 85% compared to 1990. NCCMA sets a long-term objective of reaching net-zero emissions by 2050. The targets set in the NCCMA are summarised in Table 2-1.

Table 2-1. *National climate change mitigation targets set in the NCCMA*

GHG emission reduction targets	2030	2040	2050
Compared to 1990 level*	≥ -70 %	-85 %	-100 %
Compared to 2005 level*	≥ -30 %	–	–
For ETS sectors, compared to 2005 level	≥ -50 %	–	–
For non-ETS sectors, compared to 2005 level*	≥ -25 %	–	–

**Including LULUCF*

NCCMA also sets an indicative sectoral GHG emission reduction targets by 2030 compared to 2005 emission level, which are presented in the Figure 2-2 below.

[5] Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU https://eur-lex.europa.eu/eli/reg/2018/841/oj

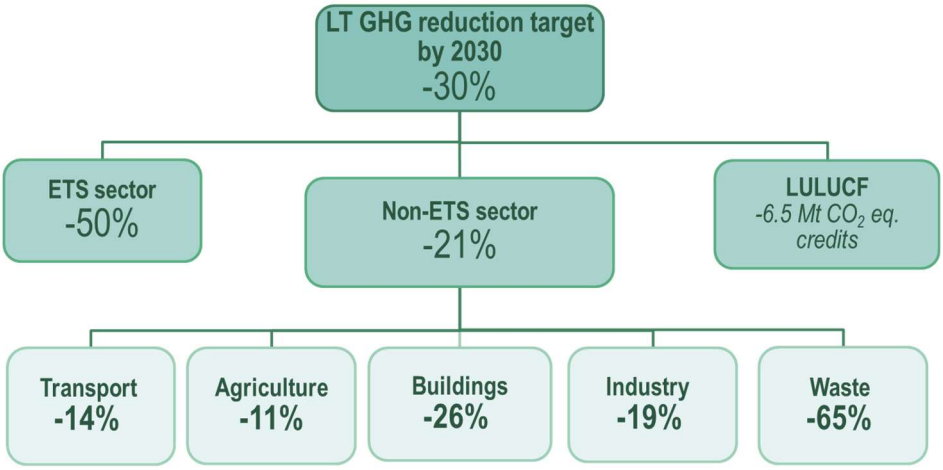

Figure 2-2. Lithuania's GHG reduction targets by 2030 compared to 2005

To support the implementation of climate change mitigation targets and requirements of Regulation (EU) 2018/1999 on the Governance of the Energy Union and climate action **Lithuania's National Energy and Climate Action Plan** (NECP) for the period 2021–2030 was adopted in December 2019 and updated in October 2024. The NECP has been prepared based on and integrating the provisions, objectives, and tasks of the Lithuanian national legislation, international obligations, strategies, and other planning documents, as well as measures being implemented and planned to be implemented. The NECP sets a number of policies targeting economy-wide emissions reductions. Rather than setting economic incentives or introducing new regulations, these are primarily complementary policies, for example integrating GHG emissions reduction evaluations into the legislative process, mainstreaming climate change within educational programmes, extending the scope for green procurement, increasing public awareness, and funding research on climate mitigation. The policies and measures set in the NECP were revised in 2021–2024 to meet the increased ambition of the European climate legislation (EU "Fit for 55" package and REPowerEU plan) and GHG reduction targets set in Lithuania's National Climate Change Management Agenda and on 3rd October 2024 Lithuania has submitted to EC updated NECP.

2.3. National Economic and Financial Instruments for Climate Change Management

The implementation of Lithuania's climate goals and the policies and measures also requires financing.

Climate Change Programme

The Ministry of Environment of Republic of Lithuania administrates a Climate Change Programme (hereinafter – Programme). As it is stated in the Law on Climate Change Management a Climate Change Programme was developed to collect additional funding for climate change management measures. All the Funds are used only for climate change mitigation and adaptation measures nationally and internationally.

The Funds for the Programme are accumulated in a separate account of the State Treasury and is regarded as part of national state budget. The Law states that the sources of financing of the Programme these:

- The funds obtained from the transfer of assigned amount units;

- The funds obtained from the auctioned allowances under the EU ETS;
- The funds obtained from the economic penalties in accordance with the procedure laid down in Chapter VII of this Law;
- The funds donated by natural and legal persons for implementation of the measures aimed at mitigation of climate change;
- The funds obtained from the sold CBAM certificates;
- Other funds received in legal ways.

The funds of the Programme are used for:

1. Energy consumption and production efficiency enhancement processes: modernization of dwelling houses and public buildings, implementation of other projects permitting most efficient reduction of GHG emissions in the energy, industry, construction, transportation, agriculture, waste management and other fields;
2. Promotion of the use of renewable energy resources, introduction of environment-friendly technologies, including efficient energy production by cogeneration;
3. Implementation of measures of the National Progress Plan, National Climate Change Management Agenda, National Energy and Climate Action Plan to increase the greenhouse gas removals capacity of land use, land use change and forestry sector;
4. To increase the GHG absorption capacity of the land use, land use change and forestry sector;
5. Provision of information to and education of the public, scientific research and dissemination thereof, consulting and training of operators and other persons on topical issues of management and implementation of the climate change policy, enhancement of energy consumption efficiency, use of renewable energy resources and introduction of environment-friendly technologies;
6. Implementation, in the territory of the Republic of Lithuania and third countries of measures of adaptation to climate change and mitigation of climate change effects as stipulated under legal acts of the European Union, the UNFCCC, the Kyoto Protocol, Paris Agreement and other international agreements;
7. To administer Programme funds and the Union GHG registry, to prepare national greenhouse gas accounting and projecting systems, and to evaluate the impact of policies and measures on climate change mitigation.
8. To financial compensations in accordance with detailed rules laid down in the implementing act of the European Commission for final fuel users where double counting or the surrender of emission allowances for greenhouse gas emissions from fuel released for consumption cannot be avoided;
9. To co-finance measures set in the Social Climate plans as according to Regulation (EU) 2023/955 15 article.

The general provisions of the management of funds of the Programme are:

- since 2022 the four-year Programme investment plans, annual reports on the use of Programme funds are prepared and the Programme funds are administered by the Ministry of Environment;
- since 2022 four-year investment plans of the Programme and their amendments, discussed with Seimas Committee on Environment Protection, are approved by the Government;

- the Ministry of the Environment submits annual reports on the use of Programme funds for the previous calendar year to the Government and the Seimas Environmental Protection Committee;
- together with the four-year Programme investment plans and the annual reports on the use of Programme funds for the previous calendar year, information on the planned reductions in the amount of greenhouse gases for each financing direction is provided.

The rules for the use of Climate Change Programme funds are approved for individual measures by order of the Minister of the Environment. The funds of the Programme are managed by the Ministry of Environment, and the selection and monitoring of the Programme projects is carried out by the designated institution – the Environmental Projects Management Agency under the Ministry of Environment. Currently the Government in 2022 has approved the four-year Programme with total amount of 358.6 million EUR.

Table 2-2. *Approved financial measures under the Climate Change Programme for 2022–2025*

Year	Financial measure	Allocated proceeds, EUR million
2022–2025	Development cooperation projects	8
	Modernization of multi-apartment buildings to reduce energy consumption	48
	Modernization of private houses to reduce energy consumption	1.4
	Promotion of purchase and/or use of less polluting transport	5
	Additional funding of the 2014–2020 EU measure "Renovation of Public Central Government Buildings" under the program for increasing the energy consumption of public buildings	10
	Renovation of buildings	16
	Promotion of RES technologies	81
	Investment to support the production of biomethane	33
	Promotion of purchase and/or use of less polluting transport	12
	Promotion of the reduction of GHG emissions by legal entities	15
	Climate Neutral Government	5
	A financial incentive for non-governmental organizations	0.5
	For the implementation of the measures of the updated National Action Plan in the field of energy and climate:	**111.7**
	Renovation of buildings	*64*
	Promotion of purchase and/or use of less polluting transport	*24.6*
	Promotion of the reduction of GHG emissions by legal entities	*12.1*
	Promotion of second-generation biofuel and electric-powered agricultural machinery	*7*
	Preservation of self-sown trees and their inclusion in forest land accounting	*4*

The diagram below shows the revenues of the Climate Change Programme, the revenue depends on ETS emissions allowances prices. As well as the annual budget of the Programme shown in the diagram. Since 2022, the Programme's revenues and budget are planned for 4 years.

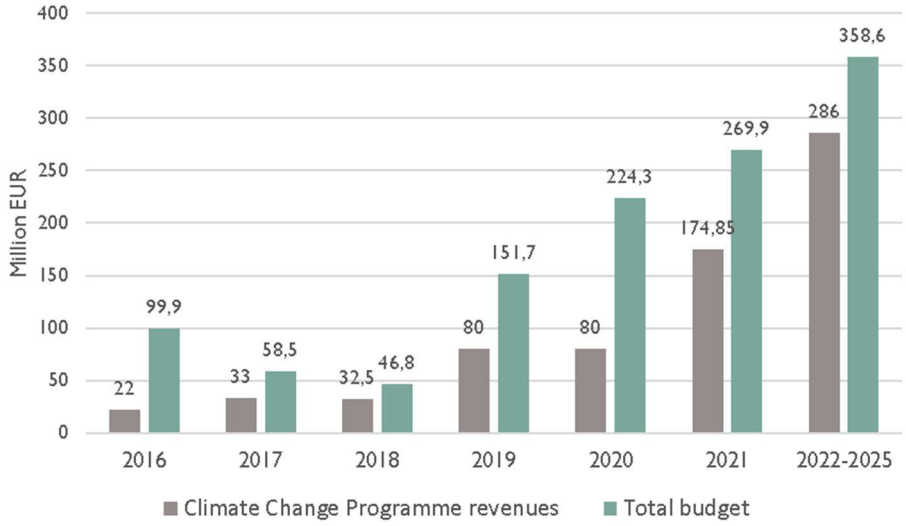

Figure 2-3. Climate Change Programme's revenues and total budget in 2016–2025, million EUR

Other financial programs for implementation of climate mitigation measures

The Modernisation Fund is a programme under the EU ETS to support 10 Member States (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia) to meet 2030 energy targets by helping to modernise energy systems and improve energy efficiency. The Modernisation Fund provides investments in generation and use of energy from renewable sources, energy efficiency, energy storage, modernisation of energy networks, including district heating, pipelines and grids, just transition in carbon-dependent regions: redeployment, re-skilling and upskilling of workers, education, job-seeking initiatives and start-ups. The total revenues of the Modernisation Fund may amount to EUR 48 billion from 2021 to 2030 (at 75 EUR/tCO_2 eq.), depending on the carbon price. Out of this amount, around EUR 28 billion comes from allowances that beneficiary Member States have transferred to the Modernisation Fund from their resources under Article 102(b) and 10c, and around EUR 20 billion comes from the auctioning of 2% of the total EU ETS allowances from 2021 to 2030.

Lithuania since 2021 has allocated 747 mill. EUR from Modernisation Fund for period 2021–2025. The total amount indicated for period of 2021–2030 for Lithuania – 1.3 billion EUR (this amount is subject to EU ETS prices).

Table 2-3. *Lithuania's financial measures for 2021–2025 from Modernisation Fund*

Year	Financial measure	Allocated proceeds, EUR million
2021–2025	Renovation (modernization) of apartment buildings	223
	Renovation (modernization) of public buildings owned by municipalities	55

Decarbonization of industry	42
Creation of electricity storage capacity	150
Promotion of green hydrogen production (including hydrogen derivatives)	80
Reduction of CO_2 emissions from the LNG terminal	6
Renovation (modernization) of public buildings owned by central government	70
Promotion of the purchase of bicycles and motorized bicycles	1
Reducing fuel costs by developing no-till farming	30
Promoting the purchase of electric vehicles	50
Implementation of cleaner production technologies in industrial enterprises participating in the EU Emissions Trading System	40
Total	**747**

The Innovation Fund is one of the world's largest funding programmes under the EU ETS for the demonstration of the most innovative low-carbon technologies. The Innovation Fund was established by Article 10a(8) of Directive 2003/87/EC to support across all Member States innovation in low-carbon technologies and processes. The EU Innovation Fund support is available to projects located in all EU Member States, Norway and Iceland.

The Innovation fund currently supports 1 project located in Lithuania which will contribute to decarbonisation of European industries with total expected GHG emissions of 16,669 t CO_2 eq. in the first 10 years of operation. The grant for this project is 2.6 million EUR out of total relevant costs of 7.5 million EUR.

Rural development. The Common agricultural policy supports the vibrancy and economic viability of rural areas through funding and actions that support rural development.

Rural development is the "second pillar" of the Common agricultural policy (CAP), reinforcing the "first pillar" of income supports and market measures by strengthening the social, environmental and economic sustainability of rural areas.

The CAP contributes to the sustainable development of rural areas through three long-term objectives:

- fostering the competitiveness of agriculture and forestry;
- ensuring the sustainable management of natural resources and climate action;
- achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment.

The CAP's contribution to the EU's rural development objectives is supported by the European agricultural fund for rural development (EAFRD). The EAFRD budget for 2021-2027 amounts to EUR 95.5 billion, which includes an injection of EUR 8.1 billion from the Next generation EU recovery instrument to help address the challenges posed by the COVID-19 pandemic.

At least 30% of funding for each Rural Development Programme must be dedicated to measures relevant for the environment and climate change, much of which is channelled through grants and annual payments to farmers who switch towards more environmentally friendly practices.

Lithuanian **Agriculture and Rural Development 2023–2027 strategic plan** (hereinafter – the strategic plan) aims at the sustainable development of the Lithuanian agricultural and food economy, increasing the added value and competitiveness of the sector, supporting the income of promising farms (especially small and medium-sized ones), the change of generations, creating a vibrant village that is attractive for farming and business and contributing to the environment and implementation of climate goals. During the 2023–2027 period almost 4 billion EUR is planned for Lithuanian agriculture and rural development from EU funds, and about 276.5 million EUR national budget funds. The strategic plan includes:

- Direct support, systems (eco-schemes) beneficial to the climate, environment and animal welfare, sectoral programs for which 3.02 billion is allocated of EU funds and about 2.8 million EUR national funding;
- For investment, cooperation, environmental protection, climate goal-seeking and other rural development measures 977.5 million EUR of EU funds and 273.7 million. EUR national funding.

Parliament adopted a law on the **Innovation Promotion Fund** in June 2020. The Fund will provide loans, guarantees and risk capital for start-ups and research and development (R&D) projects. The maximum subsidy per applicant is EUR 200,000, but the amount of the subsidy for a project may not exceed 70% of total eligible costs. The funding guidelines may set a lower amount.

EU funds and the Waste Management Programme finance new waste collection measures, recycling infrastructure and its development to help municipalities to collect and recycle more waste. The programme is funded from revenues of the tax on environmentally harmful products and packaging (paid by producers and importers) and of the landfill tax. The funds finance the setting-up, operation and development of waste management schemes, including investment projects. The programme also supports training, education and provision of information to the public and municipal staff related to waste management. It can also provide grants to municipalities and subsidies to economic entities to operate and develop waste management schemes.

In August 2022 the European Commission approved **Lithuania's Programme for the European Union (EU) Funds' Investments 2021–2027**, according to which it is planned to invest almost 8 billion EUR. Europeans, investments are aimed at ensuring Lithuania's future well-being: investments in energy security, innovation and green economy, high quality education, social and medical services for both city and regional residents, jobs for new generations.

The **EU cohesion policy** will ensure the long-term economic and social well-being of the Lithuanian population, and to strengthen the resilience of our country's economy. The EU cohesion policy allows promoting economic, social and territorial cohesion, green and digital transitions and thus contributes to Lithuania's competitive, innovative and sustainable growth, focused on the quality of life of its citizens.

The Programme for the EU Funds' Investments 2021–2027 includes the investments of **the European Regional Development Fund, the Cohesion Fund, the "European Social Fund"** and Just Transition Fund planned to be targeted in the following areas:

Smarter Lithuania – competitiveness of the economy and transition to the economy with the higher added value;

Greener Lithuania – transition to clean energy, green investments, circular economy, adaptation to climate change, risk prevention and management of extreme climate events;

Better connected Lithuania – digital connectivity, cross-border and national, regional and local mobility, sustainable, advanced, safe and diverse trans-European transport network;

More socially responsible Lithuania – investments in people and systems in the fields of employment, education, health, social inclusion and cultural policies;

Lithuania closer to its citizens – sustainable and integrated development of cities and villages and local initiatives in order to respond to demographic challenges and reduce social and economic disparities;

Social innovation – activities aimed at the implementation of new ideas related to products or services, the benefits of which are provided to the society, are funded;

Digital infrastructure – development of very high-capacity broadband networks in "white spots" identified according to the analysis of investment needs;

Sustainable mobility – financing of relevant measures provided for in the sustainable mobility city plans of 18 cities and resorts in Lithuania.

For the even development of the country, investments will be made in 10 regional centres of Lithuania, realizing their economic potential. In this way, the benefits of investments would be felt not only by the residents of a specific city, but also the entire region.

Almost 47% of the Programme funds will be allocated to investments in innovations and green transition – sectors that will create the greatest added value for the Lithuanian economy in the long term.

30% of the Programme funds will be targeted to the strengthening of human capital, solving the challenges of social inclusion and improving achievements in the fields of education, health, culture and ensuring high employment rates in the labour market.

EUR 1.62 billion will be allocated to regions that will plan investments themselves and enable communities to agree among themselves on necessary projects that are important to the strategy and vision of that region.

In 2022 the Programme for the European Union Funds' Investments 2021–2027 the calls for proposals in the amount of EUR 1.1 billion are announced in energy, transport, education, health, culture, and social areas.

A total of EUR 8 billion of the EU Funds' investments are planned in Lithuania after the European Commission approved Lithuania's Territorial Just Transition Plan (TJTP) from **Just Transition Fund** on 14 December 2022. Under the TJTP activities are orientated towards two directions: industry decarbonisation and the creation of sustainable jobs. All investments are dedicated to three regions that are mostly affected by the transition towards climate neutrality: Kaunas, Šiauliai and Telšiai regions and municipalities operating in Jonava, Akmenė and Mažeikiai. Totally 273 million EUR will be invested to diminish the consequences of the transition. EU funding will support the introduction of 'green' hydrogen and other innovative solutions into production processes, as well as the establishing green jobs in the regions.

The Economic Recovery and Resilience Facility proposed by the European Commission is the main component of the joint "Next Generation EU" instrument of 750 billion EUR for economic recovery and preparation for future challenges, therefore the national integrated draft plan is called **"New Generation Lithuania"** in response to a common European context. 2.225 billion EUR is planned for Lithuania for grants and up to 3 billion EUR for loans. "New Generation Lithuania" milestones:

- **In the field of renewable electricity production**, to prepare for the construction of wind farms in the Baltic Sea, investments in preparatory seabed and technical research will be made, it is planned to support business and population investments in solar and wind power plants.

- **In the field of sustainable transport**, it is envisaged to expand the infrastructure network for electric vehicle charging and alternative refuelling stations. At the same time, financial incentives will be provided for public sector bodies and business to replace polluting vehicles, also public transport will be refurbished.
- **In the field of energy efficiency**, a reform of the renovation of buildings will be implemented. The goal is 1,000 multi-apartment buildings to be renovated per year.
- **In the field of digital innovation**, it is planned to develop innovations in data and digitalisation technologies in business through artificial intelligence, blockchains and automation. A separate priority is given to the flagship initiative – digitisation of the Lithuanian language resources, which would allow local and foreign market products or services "to speak" in Lithuanian (e.g. smart home management systems, Amazon Alexa, Apple Siri).
- **In the field of education**, it is planned to implement complex measures in general education with a view to improving students' achievements and reducing the gap. The aim will be to optimise the school network by investing in the Millennium schools, also the investments will be designated to increase the attractiveness of vocational training.
- **In the field of science and innovation**, it is planned to encourage the transformation of research and education institutions in such a way that the international competitiveness of studies in Lithuania, scope of scientific research and its quality would grow significantly. It is planned to improve the system of funding of studies and student enrolment by ensuring better compliance with labour market needs, to increase the efficiency of study quality assessment and to ensure systematic monitoring of R&D activities.
- **In the field of health**, investments are planned to modernise infectious diseases cluster centres in 5 major cities, which will ensure accessible, high-quality infectious disease diagnostic and treatment services for the population, as well as safe working conditions for personnel. The reception units for 10 health institutions at regional level will also be modernised. This will ensure preparedness of the major hospitals of the country to effectively provide emergency medical services to many patients at a time in the event of an emergency (chemical pollution, radioactive contamination, nuclear accident terrorism, epidemic of communicable diseases).
- **In the field of labour market and social inclusion**, it is planned to create opportunities for jobseekers to learn and acquire high value-added qualifications and competences, as well as to subsidise job creation which contribute to the objectives of digital and green transformation. It is envisaged to subsidise job creation for persons affected by the operational changes of the company due to the COVID-19 pandemic.
- **In the field of efficiency of the public sector**, it is planned to invest in the improvement of STI and Customs activities through the introduction of advanced IT technologies, as well as to encourage reduction of cash payments, to conduct financial education of the public to create opportunities for the reduction of VAT non-collection and shadow economy. The efficiency of the activities of civil servants will be increased – centralised management of human resources and managerial careers, investments in strategic competences.
- **National Energy and Climate Action Plan (NECP) of Lithuania** (2024) by implementing the EU climate and energy policy targets till 2030 were conducted the total investments to be financed 31 billion EUR investments, of which 13 billion EUR could be public funds. Most of the funds will be dedicated to the implementation of the goals of national energy independence and Lithuania's obligations to the EU regarding the mitigation of climate change – to promote technological and operational changes in different sectors. Also, 2.2 billion EUR planned for adaptation to climate change.

2.4. National policies and measures in different sectors

The climate change mitigation targets are closely linked to the energy efficiency targets defined in the National Energy Independence Strategy, the National Renewable Energy Development Programme, the Long-term Renovation Strategy, the Renewable Energy Law, the Alternative Fuels Law and the current NECP.

Lithuania's Strategy for Progress "Lithuania 2030" highlights the need for joint work to address challenges in the areas of sustainable development, the environment, energy, transport, the economy and strengthening democracy, but does not elaborate further. There is a strong focus on social responsibility and green growth. The National Progress Plan (NPP) states that Lithuania aims to adequately implement Lithuania's commitments to sustainable development and climate change mitigation and to decouple economic growth from GHG emissions. The Plan's Strategic Objective 6 aims to ensure good environmental quality and sustainability in the use of natural resources, to protect biodiversity, and to mitigate Lithuania's impact on climate change and build resilience to its impacts.

In this section, policies and measures are grouped and presented by sector. Detailed measures and the necessary policies in place are discussed under each of the sectors where GHG emissions and removals are to be improved, considering the long-term vision and objective of building a low-carbon economy and ensuring a balance between emissions and removals in line with the Paris Agreement.

The following are the policies and measures applicable to the ETS, non-ETS and LULUCF sectors that will be implemented or are planned to be implemented to achieve the GHG emission reduction targets by 2030.

2.4.1. Energy

Energy efficiency

Improving energy efficiency (EE) is one of the key priorities in the energy sector until 2050, as established in the National Energy Independence Strategy (NEIS) approved in 2018 and updated in 2024. The NEIS goals in the field of energy efficiency are aligned. Lithuania, aiming to achieve these objectives, has identified the following priority directions:

- ✓ Promoting the comprehensive renovation of residential (apartment blocks and individual houses) and public buildings, with a focus on district-wide renovation, to save up to 18.6 TWh of energy by 2030. Encouraging the industrial sector to develop, adopt, and advance innovative, energy-efficient, and environmentally friendly technologies and equipment.
- ✓ Increasing EE in the transport sector by modernizing the vehicle fleet, transitioning to efficient public transport, optimizing transport infrastructure, and expanding the use of alternative fuels, including electrification.

In 2021 the Government of the Republic of Lithuania approved the **Long-term Renovation Strategy**, which aims for all public and private buildings in Lithuania to become completely independent from fossil fuels and achieve a zero-carbon footprint by 2050. The implementation plan for the Long-term Renovation Strategy was approved in 2022 by the Minister of Environment. One of the plan's key elements is district-wide comprehensive renovation. In 2023 the Minister of Environment established

a working group to develop a model for district-wide renovation and pilot projects, which will help refine this approach.

The Strategy sets out implementation indicators and intermediary targets for 2030, 2040, and 2050. Over the next three decades, the plan envisions creating favourable conditions for the cost-effective modernization of 440,000 buildings or about 110 million square meters of their total area. The strategy aims to reduce the annual primary energy consumption of the building stock by 60% compared to 2020 levels, transition from fossil fuel-based primary energy to renewable sources and achieve a 100% reduction in CO_2 emissions.

In the transport sector, the National Climate Change Management Agenda (NCCMA) sets the following EE goals by 2030:

- By 2027, all public transport, taxis, and ride-sharing vehicles in major cities will use only renewable energy sources.
- Zero-emission vehicles (electric and other) will comprise at least 20% of the light vehicle fleet, with a corresponding expansion of the required infrastructure.
- Increase the share of zero-emission vehicle purchases:
  - By 2025, M1 electric vehicles will make up at least 10%, and N1 vehicles at least 30% of annual purchases.
  - By 2030, M1 electric vehicles will comprise at least 50%, and N1 vehicles 100% of annual purchases.
  - Starting January 1, 2030, new registrations of internal combustion N1 vehicles will be prohibited, except for those powered by alternative fuels.
  - By December 31, 2030, ensure that all vehicles acquired through public procurement are zero-emission: 100% for M1, M2, M3, and N1 categories; 16% for N2 and N3 categories.
  - By 2035, reduce fossil fuel use in road transport by 50% and ensure that passenger and logistics services in cities use only zero-emission vehicles.

The policies and measures in the energy (energy efficiency) sector are presented in the table below.

Table 2-4. *The existing and planned measures in the energy (energy efficiency) sector*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
EE1-E	Impact of higher excise duties and taxes on fuel consumption	2021–2030	Ministry of Energy, Ministry of Finance, Ministry of Environment	**	8,657.20
EE2-E	Renovation/modernisation of multiapartment buildings	2021–2026	Ministry of Environment, Environmental Project Management Agency	206.32	5,293.03
EE3-E	Renovation of public (central government) buildings	2021–2028	Ministry of Energy,	20.32	409.86
EE3-E	Renovation of public (municipalities) buildings	2021–2024	Ministry of Environment		
EE4-E	Agreements with energy suppliers on consumer education and advice	2021–2030	Energy suppliers, Ministry of Energy	248.96	2,773.21

EE5-E	SPI relief for industrial enterprises	2021–2028	Ministry of Energy, JSC “Baltpool”	110.27	4,227.70
EE6-E	Agreements with state and municipally owned enterprises on energy saving	2021–2030	Ministry of Energy, State and municipally owned enterprises	107.66	3,744.84
EE7-E	Replacing boilers with more efficient technologies	2021–2030	Ministry of Energy, Environmental Project Management Agency, Lithuanian Energy Agency	276.05	7,622.81
EE8-E	Modernization of indoor heating and hot water systems of buildings (“small renovation”)	2021–2022	Ministry of Energy, Environmental Project Management Agency	3	29.94
EE9-E	Implementation of energy efficiency measures by private legal entities based on energy audit reports	2021–2024	Ministry of Energy	24.89	179.35
EE10-E	Renovation (modernisation) of one or two–apartments of residential houses owned by private persons	2021–2022	Ministry of Environment	23.34	611.44
EE11-E	Modernisation of street lighting systems	2021–2023	Ministry of Energy	7.93	168.82
EE15-E	Renovation of non-residential buildings owned by legal entities	2021–2023	Ministry of Environment	0.92	17.11
	Planned policy measures				
EE2-P	Renovation/modernisation of multiapartment buildings	2024–2030	Ministry of Environment, Environmental Project Management Agency	293.06	3,196.42
EE3-P	Renovation of public (central government) buildings	2024–2030	Ministry of Energy	12.72	280.35
EE3-P	Renovation of public (municipalities) buildings	2024–2030	Ministry of Environment		
EE7-P	Replacing boilers with more efficient technologies	2025–2030	Ministry of Energy, Environmental Project Management Agency, Lithuanian Energy Agency	50.66	1,217.18
EE8-P	Modernization of indoor heating and hot water systems of buildings (“small renovation”)	2023–2030	Ministry of Energy, Environmental Project Management Agency, Lithuanian Energy Agency	20.37	181.16
EE10-P	Renovation (modernisation) of one or two–apartments of residential houses owned by private persons	2023–2030	Ministry of Environment	191.96	1,199.43
EE11-P	Modernisation of street lighting systems	2024–2030	Ministry of Energy	4.96	104.28
EE12-P	To increase the technological and energy efficiency of industrial enterprises by implementing artificial intelligence and digital twin technologies	2026–2030	Ministry of Energy, Ministry of Economy and Innovation	4.47	37.13

EE13-P	Create a legal requirement for companies to implement measures recommended in energy efficiency audits	2027–2030	Ministry of Energy	24.32	260.28
EE14-P	Promoting the installation of internal energy efficiency monitoring systems in businesses and industry	2025–2030	Ministry of Energy, Ministry of Economy and Innovation	26.27	214.88
EE15-P	Renovation of non-residential buildings owned by legal entities	2024–2030	Ministry of Environment	156.61	526.12
EE16-P	Implementation of complex urban renovation	2025–2030	Ministry of Environment	**	**

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

Descriptions of the policy measures:

EE1-E. Impact of higher excise duties and taxes on fuel consumption. Higher excise duties on fuel reduce fuel consumption, which increases energy efficiency in the transport sector. Lithuania has introduced higher excise duties and VAT on fuels, i.e. petrol, liquefied natural gas and diesel, to increase energy efficiency in the transport sector. Lithuania levies a 21% value-added tax on fuel, 6 percentage points above the EU minimum of 15%. Currently, excise duties on motor gasoline with a fixed component only are as follows: unleaded gasoline at an excise rate of €466 per 1,000 litres of product, leaded gasoline at an excise rate of €579.24 per 1,000 litres of product. Diesel is subject to an excise duty rate of €410 per 1,000 litres of product. Liquefied petroleum gas is subject to an excise duty rate of EUR 304.10 per tonne of product. In 2030, the energy savings due to higher taxes and excise duties on fuels are projected at 8.66 TWh (2021–2030).

EE2-E. Renovation/modernisation of multiapartment buildings. Lithuania will continue to prioritise the renovation of multi-apartment buildings, reduce consumers' heating bills and improve living conditions in multi-apartment buildings. The Multi-apartment Building Renewal Programme will continue to be implemented. This existing measure runs from 2021–2026. The renovation of the building should result in a B or C class building and annual energy savings of 40% of the building's energy consumption. The measure should renovate around 2,269 apartment blocks by the end of 2026 and save 5.29 TWh of energy (2021–2026).

EE3-E. Renovation of public (central government and municipalities) buildings. The Programme for Improving the Energy Efficiency of Public Buildings sets targets for the renovation of state- and municipal-owned buildings up to 2030. For central government buildings, this measure is implemented between 2021 and 2028, for municipal buildings between 2021 and 2024. It is planned that by 2030, about 367,000 m^2 of central government public buildings and about 86,220 m^2 of municipal public buildings will be renovated. According to the current legal framework, public buildings must reach a minimum class B or C after renovation. The annual energy savings will be around 8 GWh and the total energy savings of this measure will be around 0.41 TWh (2021–2028 for central government; 2021–2025 for municipalities).

EE4-E. Agreements with energy suppliers on consumer education and advice. The aim of these agreements is to educate and advise consumers on energy-saving measures and solutions that change consumer behaviour and habits to improve energy efficiency. Energy suppliers will ensure the implementation of the scope of consumer education and advice, and the measures provided for in the

agreements between them or through other parties. The implementation of this measure and the change in consumer behaviour is expected to result in energy savings of 2.77 TWh by 2030 (2021–2030).

EE5-E. SPI relief for industrial enterprises. A support mechanism that will finance the implementation of energy efficiency improvement measures in all major Lithuanian industrial enterprises that consume more than 1 GWh of electricity per year. Companies will receive compensation for the implementation of energy efficiency improvement measures – they can recover 85% of the cost of the public service paid for electricity consumption exceeding 1 GWh in the previous calendar year, provided that the recovered funds are used to invest in energy saving measures. It is planned that energy efficiency measures will be installed annually, resulting in annual energy savings of around 77 GWh and 4.23 TWh of energy savings by 2030 (2021–2028).

EE6-E. Agreements with state and municipally owned enterprises on energy saving. Energy companies will make energy savings in line with the energy levels specified in the energy savings agreements (by themselves or through others), by applying economically sound energy efficiency improvement measures at the end-users' installations (plant, equipment, transport). This measure is expected to result in annual savings of around 68 GWh and by 2030 around 3.75 TWh (2021–2030).

EE7-E. Replacing boilers with more efficient technologies. The implementation of the measures set out in the plan will achieve the key objective of replacing 50,000 boilers in households by 2030 and adopting other heat efficiency measures, which will result in savings of at least 139 GWh annually or 7.62 TWh by 2030. The plan is to upgrade 5,000 boilers per household each year. This measure will compensate up to 50% of the costs incurred by households not connected to the district heating supply system for the replacement of inefficient individual boilers with individual boilers using more efficient technologies (2021–2030).

EE8-E. Modernization of indoor heating and hot water systems of buildings ("small renovation"). A financial instrument that will encourage building owners to upgrade old elevator-type heat points to a newer single-loop heat point. This existing measure was implemented between 2021 and 2022. It is planned to reimburse up to 60–80% of the investment costs and to upgrade 158 heat points. This would lead to energy savings of around 0.03 TWh by 2030 (2021–2022).

EE9-E. Implementation of energy efficiency measures by private legal entities based on energy audit reports. To improve the energy efficiency of businesses, Lithuania has designed a financial instrument that will encourage businesses to implement energy efficiency measures identified in energy audits. This existing measure runs from 2021 to 2030. It is planned to provide a subsidy for the energy savings achieved in 44 projects, which will result in energy savings of almost 0.18 TWh by 2030 (2021–2030).

EE10-E. Renovation (modernisation) of one or two–apartments of residential houses owned by private persons. Financial incentives for owners of individual houses to renovate their individual houses. This existing measure was implemented between 2021 and 2022. The obligation is to achieve an energy performance class of the house at least B and to reduce the calorific thermal energy consumption (kWh/per square metre of useful floor area of the building (part of the building) per year) by at least 40% compared to the calorific thermal energy consumption before the renovation/modernisation. 1,106 individual houses are planned to be renovated. Up to 30% of the investment costs are reimbursed. The total cumulative energy savings up to 2030 are 0.61 TWh (2021–2022).

EE11-E. Modernisation of street lighting systems. Financial support to encourage the modernisation of street lighting systems and encourage municipalities to save electricity. This existing measure runs from 2021–2023. The aim is to replace and upgrade about 69,353 luminaires. By 2030, it is estimated that around 0.17 TWh of electricity will be saved, or around 3 GWh annually (2021–2023).

EE15-E. Renovation of non-residential buildings owned by legal entities. Financial incentives for legal entities to renovate non-residential buildings. The obligation is to achieve an energy performance class of at least B and to reduce the calculated thermal energy consumption by at least 40% compared to the calculated thermal energy consumption before renovation/modernisation. This measure is expected to save 0.017 TWh of energy by 2030 (2021–2023).

EE2-P. Renovation/modernisation of multiapartment buildings. This measure will be a continuation of the EE2-E measure and will be implemented between 2024 and 2030. The measure will require a multi-apartment building to be upgraded to class B and deliver 40% energy savings. By the end of 2030, 5,042 apartment buildings are to be renovated, of which 860 are to be renovated/retrofitted using standardised modular products (panels) manufactured in a factory from renewable natural organic resources. This measure is expected to result in total energy savings of 3.20 TWh by 2030 (2024–2030).

EE3-P. Renovation of public (central government and municipalities) buildings. The measure will be a continuation of the EE3-E measure, to be implemented between 2024 and 2030. The measure will require public buildings to be renovated to near-zero emissions and will renovate around 143,000 m^2 of central government public buildings and 36,370 m^2 of municipal public buildings by 2030. This measure is expected to result in total energy savings of 0.28 TWh by 2030 (2024–2030).

EE7-P. Replacing boilers with more efficient technologies. By 2030, 11,305 boilers will be replaced by heat pumps in households, which will result in savings of around 58 GWh per year and 1.22 TWh by 2030 (2025–2030).

EE8-P. Modernization of indoor heating and hot water systems of buildings ("small renovation"). The measure will be a continuation of the EE8-E measure and will be implemented from 2023-2030. The measure plans to upgrade 290 heat points each year. By 2030 the measure is expected to deliver total energy savings of 0.18 TWh. It should be noted that in multi-apartment buildings where heat points and other indoor heating and hot water systems have not been upgraded, there is a high proportion of low-income and energy-poor residents who currently overpay for heating and are therefore entitled to compensation for heating costs. Therefore, the implementation of this measure will not only contribute to higher energy savings, but also to a reduction in the costs and thus the compensation of the underprivileged population, and to a reduction in the cost of heating (2023–2030).

EE10-P. Renovation (modernisation) of one or two–apartments of residential houses owned by private persons. The measure will be a continuation of the EE10-E measure, to be implemented from 2023–2030. It will provide a financial incentive for owners of individual houses to renovate their individual houses. The obligation is to achieve an energy performance class of at least B and to reduce the calorific thermal energy consumption (kWh/per square metre of useful floor area of the building (part of the building) per year) by at least 40% compared to the calorific thermal energy consumption before the renovation/modernisation. In total, the measure plans to renovate 18,000 individual houses, which will result in energy savings of 1.12 TWh by 2030 (2024–2030).

EE11-P. Modernisation of street lighting systems. The measure will be a continuation of measure EE11-E, to be implemented between 2024 and 2030.The total number of luminaires to be replaced

under this measure will be around 100,000, which will result in energy savings of 0.1 TWh by 2030 (2024–2030).

EE12-P. To increase the technological and energy efficiency of industrial enterprises by implementing artificial intelligence and digital twin technologies. It is an investment measure to be implemented between 2026 and 2030 to increase the level of automation and efficiency of industrial enterprises. The measure will provide subsidies for the introduction of digital twin or artificial intelligence solutions for the digitisation of all or part of a company's processes. The measure combines fully real-time data-driven in-house decision-making, which saves energy and costs; IoT-enabled automated production line optimisation – comparing current data (parameters) with historical data and continuously informing about energy efficiency deviations, and intelligent video monitoring solutions for line errors, thus reducing the need for human labour and increasing efficiency; machine learning algorithms based on artificial intelligence to anticipate, manage and prevent potential cost and energy consumption increases, as well as to identify and prevent potential energy quality problems in advance, analyse different energy consumption scenarios. The intensity of the subsidy will be up to 50%. The measure is expected to save 0.04 TWh of energy by 2030, or approximately 0.7 GWh annually (2026–2030).

EE13-P. Create a legal requirement for companies to implement measures recommended in energy efficiency audits. This is a new planned regulatory measure that is scheduled to start implementation in 2027. As part of the measure, a provision will be added to the Energy Efficiency Improvement Act and/or the description of the procedure for energy audits to oblige companies to install the measures recommended in the energy audit with an estimated payback period of up to 5 years. This measure is expected to save 0.26 TWh of energy by 2030 (2027–2030).

EE14-P. Promoting the installation of internal energy efficiency monitoring systems in businesses and industry. It is a financial instrument designed to reduce energy costs for businesses. It is designed to encourage companies to start measuring and monitoring their energy waste. This is a more effective way to monitor the evolution of their energy consumption than using bills or a meter. The measure will be implemented between 2025 and 2030 with a support intensity of up to 40%. The measure is expected to save 0.215 TWh of energy by 2030 (2025–2030).

EE15-P. Renovation of non-residential buildings owned by legal entities. Upgrade non-residential buildings to class B and save 40% of energy. This measure is expected to save 0.53 TWh of energy by 2030 (2024–2030).

EE16-P. Implementation of complex urban renovation. The measure aims to develop and validate an integrated neighbourhood-based sustainable action model and methodological material for Lithuanian municipalities to validate a long-term neighbourhood-based urban renewal plan (2025–2030), based on national and city master plans.

Renewable energy sector

Lithuania has been proactive in developing renewable energy sources (RES), achieving its EU-mandated target of 23% RES in final energy consumption by 2020 as early as 2014. This progress has been guided by the National Energy Independence Strategy (NEIS), which sets ambitious long-term goals across various energy sectors. By 2030, Lithuania aims to reach a 55% share of RES in final energy consumption and 100% RES in electricity consumption.

In the transport sector, Lithuania plans to transition gradually to alternative fuels and electricity. By 2030, the RES share in transport is expected to reach at least 15.8% without applying multipliers from Directive 2018/2001 and surpass 29% with them. To achieve this, several measures have been implemented, such as increasing mandatory biofuel blending ratios to 6.6% for gasoline and 6.2% for diesel, calculated by energy value. Public procurement rules now require at least 100% of newly acquired passenger cars and buses to be non-polluting, and 16% of new heavy vehicles must also meet these standards by 2030. Advanced biofuels and other RES fuels are to comprise at least 3.5% of fuel suppliers' balances by 2030, with biogas and non-biological gaseous fuels reaching a minimum 5.2% share of transport energy consumption. Additionally, the share of electric vehicles is expected to grow significantly, with 40% of annual new vehicle registrations required to be electric by 2030.

Lithuania has set the ambitious target of covering 100% of its electricity consumption with RES by 2030. To achieve this, the NEIS promotes the development of prosumers – electricity users who generate their own energy. The country aims to have at least 300,000 active and community energy participants by 2030, with community energy projects accounting for at least 1% of the national RES generation capacity. In the heat sector, the primary goal is to fully decarbonize by 2050, transitioning to climate-neutral heating technologies. By 2030, RES must constitute at least 90% of the fuel mix in district heating, and by 2050, all heat energy should be produced from biomass and other RES. This strategy focuses on local RES development, flexible systems, and the deployment of modern, environmentally friendly technologies to ensure efficiency and investment appeal.

The Hydrogen Development Guidelines for 2024–2050 outline Lithuania's vision for integrating hydrogen technologies into industry, transport, and energy production. These guidelines set the foundation for developing flexible green hydrogen production, transport infrastructure, and a competitive market. By 2030, surplus RES capacity will support hydrogen production, and cooperation with international markets will facilitate exports. From 2030 to 2050, hydrogen technologies are expected to expand into sectors where fossil fuel dependency is particularly challenging to eliminate, with green hydrogen adoption in industry reaching 42% by 2030 and 60% by 2035. On 11th December 2024 by Governmental Resolution No. 1070 on the Approval of the **Action Plan for the implementation of the Hydrogen Development Guidelines in Lithuania in 2025–2027** was adopted. The Plan includes tasks and measures to create a green hydrogen ecosystem and infrastructure in Lithuania, to identify the main tasks and measures for green hydrogen development by 2030, which would implement Lithuania's energy independence goal and GHG reduction commitments, and to promote climate-neutral economic development of Lithuania.

Lithuania's broader renewable energy commitments include promoting innovative technologies, aiming for at least 5% of newly installed RES capacity to come from innovative solutions. Collaborative projects with other EU member states will also play a key role, with at least two joint projects planned by 2030. Additionally, Lithuania seeks to increase the share of RES in industrial energy use by 1.6 percentage points annually between 2021 and 2030, and to ensure that 49% of energy consumed in buildings comes from RES by 2030.

The policies and measures in the energy (renewable energy) sector are presented in the table below.

Table 2-5. *The existing and planned measures in the energy (renewable energy) sector*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
AEI1-E	Financial support for generating consumers	2023–2029	Ministry of Energy	***	0.67
AEI2-E	RES development in the Baltic Sea	2003–2030	Ministry of Energy, Lithuanian Energy Agency	***	7.87
AEI3-E	RES use in public and residential buildings	2021–2030	Ministry of Environment	12.71	0.07
AEI4-E	RES power plants and storage facilities installation for legal entities and RES communities	2020–2026	Ministry of Energy	***	0.50
AEI5-E	Promoting the deployment of energy storage devices in households	2023–2029	Ministry of Energy	***	0
AEI6-E	Creating energy resource communities in municipalities, with a share of the power plants built going to the poor (energy-deprived) population	2024–2029	Ministry of Energy	***	0
AEI7-E	Solar and wind power plants in the business sector	2024–2029	Ministry of Energy	***	0.18
AEI8-E	Creation of electricity storage facilities	2024–2029	Ministry of Energy	***	**
AEI9-E	Reducing the volume of CO_2 emissions from the LNG terminal into the environment	2023–2028	Ministry of Energy	71.47	**
AEI16-E	Renew and/or modernize the heat transfer network and its devices/elements	2015–2023	Ministry of Energy	65.52	0
AEI17-E	Promoting the use of RES in district heating	2014–2023	Ministry of Energy, Municipalities	2,083.84	3.33
AEI18-E	Modernising the heat accounting system	2023–2030	Ministry of Energy	1.20	0.04
AEI19-E	Transition of DH networks to generation IV heat supply systems	2023–2030	Ministry of Energy	0.46	0
		Planned policy measures			
AEI20-P	Encouraging electricity consumers to choose energy produced from RES	2024–2026	Ministry of Energy	**	**
AEI21-P	Recommendations for the development of citizen energy communities in Lithuania (policy guidelines and methodological guide)	2024–2026	Ministry of Energy	**	**

AEI22-P	Targeted and correct education of schoolchildren and students about the possibility of obtaining energy from RES and its benefits	2025–2030	Ministry of Energy, Ministry of Education, Science and Sport	**	**
AEI27-P	Restriction of fossil fuel use by location	2024–2030	Ministry of Environment, Municipalities	**	0

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

**** – The measure implements renewable energy solutions that do not directly contribute to fuel and energy savings but ensure the deployment of clean technologies.*

Descriptions of the policy measures:

AEI1-E. Financial support for generating consumers. To encourage active participation of electricity consumers in the market, the Generating Consumers Scheme was established in 2015. By 2030 we aim to have at least 300,000 generating and active (including community energy players) consumers.

To ensure that all electricity consumers can benefit from the Generating Consumer Scheme, the purchase of a power plant is supported by the European Union Structural Funds and the national Climate Change Programme. From 2019, the Producing Consumers Allowance is paid per 1 kW of installed capacity of a solar PV power plant or purchased capacity from a remote power park. By creating an attractive financing instrument, it contributes to the Commission's objective set out in its Communication "An EU Solar Energy Strategy" to promote the rapid and massive deployment of light power plants through the European Solar Rooftop Initiative (2018–2023).

AEI2-E. RES development in the Baltic Sea. In 2020 and 2023, decisions have been taken on the parts of the Baltic Sea where it is appropriate to organise tenders for the development and operation of RES and the installed capacity of these plants. In 2022, amendments were made to the Laws on Renewable Energy and on Electricity, which resulted in the approval by the State Energy Regulatory Council of the description of the procedure for organising calls for tenders for the use of the maritime territory for the development and operation of renewable energy plants and for the issuance of permits for the use of the parts of the maritime territory for the development and operation of renewable energy plants, which regulates the procedures and procedures for the conduct of the tenders. The construction of power plants in the Baltic Sea can only be carried out after winning a call for tenders for a permit for the use of a part of the maritime territory for the development and operation of power plants using renewable resources. On 30 March 2023, one call for applications for a permit for development and operation in the area covered by the Government Decision was published. Electricity production is expected to start around 2030. Electricity production is expected to start around 2030. A Resolution of the Government of the Republic of Lithuania on the area and capacity of offshore power plant development was adopted on 22 June 2020 and revised on 15 March 2023. The call for competition for the development and operation permit for the area covered by this Government Decision was published on 15 January 2024, but due to the insufficient number of bidders, it did not take place and will therefore be re-published. The aim is to develop and connect two offshore wind farms to the onshore grid around 2030, generating around 6 TWh of electricity per year, and to organise a call for competition for the development of offshore wind farms of up to 1.4 GW capacity (2020–2030).

AEI3-E. RES use in public and residential buildings. A grant from the Climate Change Programme promotes the use of renewable energy sources (solar, wind, geothermal, biofuels, etc.) in public and residential buildings (for different social groups). By creating an attractive funding instrument, it contributes to the Commission's objective set out in its Communication "An EU Solar Energy Strategy" to promote the rapid and massive deployment of light energy plants through the European Rooftop Solar Initiative (2021–2030).

AEI4-E. RES power plants and storage facilities installation for legal entities and RES communities. The measure aims to encourage legal entities and renewable energy companies to invest in renewable electricity generation and individual storage facilities. It is intended to support investments by legal persons, farmers and renewable energy communities in onshore solar and wind power plants, with priority given to self-consumption of electricity for their own use, for the needs of their farm or economic activity (2020–2026).

AEI5-E. Promoting the deployment of energy storage devices in households. The measure is designed to promote the installation of electricity storage devices in households. For the period 2023 to 2029, the target is 2021–2027. The EU Funds Operational Programme will provide grants of €3.291 million to households to install 20 MWh of electricity storage solutions (2023–2029).

AEI6-E. Creating energy resource communities in municipalities, with a share of the power plants built going to the poor (energy-deprived) population. The measure is aimed at AIEs or Citizens' Energy Communities set up by municipalities and/or municipal bodies and/or municipally owned companies with municipal shareholders to reduce energy poverty. A soft loan (up to 3% interest) with a grant of up to 50% is provided. For the construction or purchase of renewable energy plants from a fleet. Part of the installed capacity of the power plant must be distributed free of charge to energy-deprived people living in the municipality. The measure has been allocated EUR 206 million of the State budget. The plan is to develop 144 MW of RES for electricity generation (2024–2029).

AEI7-E. Solar and wind power plants in the business sector. The estimated need for the loan from REPowerEU is EUR 549 million excluding VAT, which would create 460 MW of RES for electricity generation. The financing intensity is up to 80% for private legal entities, up to 100% for public legal entities, with an equity contribution from businesses of €110.4 million excluding VAT. By creating an attractive financing instrument, it contributes to the Commission's objective set out in the Communication "An EU Solar Energy Strategy" to promote the rapid and massive deployment of light energy plants through the European Rooftop Solar Initiative (2024–2029).

AEI8-E. Creation of electricity storage facilities. The Lithuanian Transmission System Operator (TSO) has estimated that the rapid increase in intermittent wind and solar generation will lead to a significant increase in the need for increased FRR balancing capacity in the Baltic region in the coming years, from 700 MW in 2024 to 1,238 MW by 2030. Considering existing flexible generation and new projects under construction, Lithuania is expected to have a shortfall of at least 300 MW of FRR balancing capacity at the end of 2027. As the storage facilities will primarily be used to provide FRR balancing services, sufficient storage capacity is needed to ensure uninterrupted service provision for more than 99% of the time to maintain the SOGL requirement (Article 157 of Commission Regulation (EU) 2017/1485). According to the TSO's modelling, a storage facility directly connected to the grid can only provide 100% of its capacity for FRR balancing services with a capacity of 4 hours. If the storage capacity is less than 4 hours, an increase in the required balancing capacity (MW) is needed to meet the SOGL requirement for FRR availability. Accordingly, a 2-hour energy storage facility would need approximately twice the capacity to meet the SOGL reserve availability requirement. Regardless of the capacity of the future storage facilities (2-hour or 4-hour),

between 300 and 600 MW of additional capacity will need to be added to the system. Based on the current market analysis and the experience of other European countries, the current volatility of the demand for the service and the future baseload prices cannot guarantee the profitable operation of the storage facility alone. Accordingly, this requires an additional financial incentive for market players to start investing in the development of battery installations. The modelling shows that an investment subsidy of up to 30% (2024–2028) is needed to ensure the project's profitability.

AEI9-E. Reducing the volume of CO_2 emissions from the LNG terminal into the environment. The measure aims to reduce GHG emissions by up to 30% reduction of CO_2 emissions through the installation of an electricity interconnection from the LNG terminal to land. The effect of the measure is expected from 2028 (2023–2028).

AEI16-E. Renew and/or modernize the heat transfer network and its devices/elements. Modernisation of heat transmission network pipelines by replacing old (duct) type pipelines with new, ductless type pipelines, reducing technological losses in heat transmission and increasing the reliability of heat supply. Rehabilitation and modernisation of deteriorated heat transmission networks (1,000 km) (2015–2023).

AEI17-E. Promoting the use of RES in district heating. The measure includes: 1) Promotion of small-scale biofuel cogeneration. This measure provides funding for cogeneration plants under construction up to 20 MWth and 5 MW of electrical capacity (total rated thermal output between 1 MW and 20 MW) (2019–2022). 2) Installation of small-scale biofuel cogeneration plants adapted to the combustion of logging residues. This measure provides funding for cogeneration plants up to 20 MWth and 5 MW of electrical power (total rated thermal input up to 20 MW) (2023–2030). 3) Implement local and RES-based CHP projects, with priority given to Vilnius and Kaunas. In December 2016, Vilnius CHP plant was granted a €190 million loan from the European Investment Bank, secured by the European Fund for Strategic Investments – a key element of the Investment Plan for Europe. The Vilnius CHP plant will generate around 0.3 TWh of electricity. The plant will have a total electrical capacity of around 92 MW. The boiler will use only municipal waste left over after sorting and not suitable for recycling. The other two biofuel boilers, with a capacity of about 3 times that of the waste boiler, will use biofuels. The Kaunas CHP plant was not supported. A high-efficiency waste-fired cogeneration plant will be installed with an electrical capacity of about 26 MW. It will use municipal waste left over after sorting and not suitable for recycling, non-hazardous industrial waste and sludge from water treatment plants. This capacity will generate around 175 GWh of electricity annually. The activity also contributes to the flexibility of the electricity system (2014–2023). 4) Use of residual heat in central heating systems. Installations for recovering and adapting waste heat energy to the needs of central heating consumers. Heat can be recovered from wastewater treatment, from digital information data centres, from industrial plants, etc. (2023–2030). 5) Installation of heat storage tanks. The measure would install facilities to store the thermal energy produced by biofuel boilers. The accumulated "green" heat energy would be used to meet the peak demand of the heating system, avoiding the production of heat in fossil fuel plants. The final beneficiaries of the measure are heat suppliers, independent heat producers operating biofuel-fired heat production systems (2023–2030). 6) Installation of heat pumps. The adaptation of heat pumps in central heating systems is mainly related to the optimisation of the operation of biofuel systems and, for natural gas systems, to the reduction of the fossil fuel share in the balance sheet by replacing fossil fuel units wholly or partly with compressor heat pumps. The measure shall be implemented by heat suppliers and independent heat producers operating biofuel and/or natural gas fired heat production systems (2023–2030). 7) Construction of solar collector systems for district heating activities. The

measure aims at reducing the use of primary fossil fuels or biofuels for energy production. The measure is implemented by heat suppliers and independent heat producers operating biofuel and/or natural gas fired heat production systems (2023–2030). 8) Construction of boilers burning biofuels produced from logging residues. The measure aims at diversifying the fuels used for heat production and reducing the use of fossil fuels. The measure is implemented by heat suppliers and independent heat producers operating biofuel and/or natural gas fired heat production systems (2023–2030).

AEI18-E. Modernising the heat accounting system. The EU Internal Market Directive (2009/72/EC) and its amendment (2016/0380(COD)) state that in the case of a positive cost-benefit analysis assessment, all heat meters must be replaced by remote sensing by 2027 (2023–2030).

AEI19-E. Transition of DH networks to generation IV heat supply systems. This measure promotes the transition of DH networks to Generation IV heat supply systems by adapting heat transmission networks to operate in low-temperature mode, thus reducing technological losses in heat transmission (2023–2030).

AEI20-P. Encouraging electricity consumers to choose energy produced from RES. The measure aims to increase the share of final consumption of electricity produced from RES in Lithuania. An education campaign will inform the population about the principles of green energy plans and encourage them to choose green electricity (2024–2026).

AEI21-P. Recommendations for the development of citizen energy communities in Lithuania (policy guidelines and methodological guide). The measure aims to assess existing barriers and opportunities for the development of communities by identifying unjustified regulatory and administrative barriers, facilitating intra-community energy transfers, and opportunities for cross-border participation in community activities (2024–2025).

AEI22-P. Targeted and correct education of schoolchildren and students about the possibility of obtaining energy from RES and its benefits. Public education is needed as early as school age to promote the uptake of RES in society. A programme and a communication plan to promote the use of RES and the energy produced from them, involving energy sector companies, schools and higher education institutions, is planned. Examples of activities in the plan include creation of an energy ambassador initiative for students/pupils, visits to schools, visits of students to energy companies. Synergies will be identified with other energy promotion initiatives such as Energy Smart Start (2025–2030).

AEI27-P. Restriction of fossil fuel use by location. Restricting the use of fossil solid fuels for space heating in densely populated areas, i.e. where the damage from particulate matter is highest (2024–2030).

2.4.2. Transport

Obligations for the transport sector are enshrined in Objective 6.1 “Increase the share of energy from renewable energy sources and the use of alternative fuels in the transport sector, promote sustainable intermodal mobility and reduce environmental pollution caused by transport” of the 6th objective **of the National Progress Plan (NPP)** “Ensure good environmental quality and the sustainability of the use of natural resources, conserve biodiversity and mitigate Lithuania's impact on climate change and increase its resilience to its effects”.

The Transport Development Programme for 2022–2030 (the "Transport Development Programme") has also been developed in line with the objectives of the NPP for the transport sector. This Programme aims to formulate the state policy in the areas of the functioning of the transport system and the development of all modes of transport infrastructure, electronic communications and the postal service, as well as to formulate the state policy in the areas of traffic safety, transit, logistics and combined transport, passenger and freight transport by rail, road, sea, inland waterway and air, and to organise, coordinate and control the implementation of these operational objectives. The objectives set out in the NPP will be pursued through the implementation of tasks, the cross-cutting outcome of which will ensure the implementation of the horizontal principles of sustainable development, innovation (creativity) and equal opportunities for all in the field of transport, as well as the solution of identified problems and the elimination of the causes of the problems.

Specifically the implementation of objective 6.1 "Increase the share of energy from renewable energy sources and the use of alternative fuels in the transport sector, promote sustainable intermodal mobility and reduce environmental pollution caused by transport" contributes to the reduction of GHG and nitrogen oxide (NO_x) emissions in transport; increasing the share of renewable energy sources in total energy consumption in the transport sector and energy savings in the transport sector; increasing the share of cycling and other non-motorised transport in the total travel pattern and the share of train travel in the total travel pattern; and increasing the share of rail and inland waterway transport in total freight transport.

The Law on Alternative Fuels of the Republic of Lithuania provides for the development of the use of alternative fuels in the transport sector in the Republic of Lithuania. The aim of this Law is to reduce the impact of the transport sector on climate change and air pollution, so that by 2030 the share of renewable energy sources in the transport sector in relation to total final energy consumption is at least 15%. This objective is achieved by consistently increasing the diversity of energy sources in the transport sector, by imposing obligations on fuel suppliers to supply fuel from renewable energy sources, by increasing the use of advanced biofuels, by promoting the use of electricity in transport, by developing the infrastructure for alternative fuels, by increasing the number of clean vehicles registered in Lithuania and by setting requirements for public procurement in the transport sector. By 2030, 60,000 charging points should be installed in the Republic of Lithuania, of which 6,000 should be publicly accessible. Amendments to the law are currently being drafted to consider the provisions of the EU Regulation (EU) 2023/1804, which entered into force.

The National Air Pollution Reduction Plan aims to limit national emissions of SO_2, NO_x, NH_3, $PM_{2.5}$ and NMVOCs from anthropogenic sources to ambient air to meet the 2020 and 2030 targets set in the Environmental Strategy for Lithuania. The road transport sector is the largest contributor to NO_x emissions. Although NO_x emissions from trucks and buses decreased by 29.5% in 2022 compared to 2005, their share in the total NO_x emissions structure in 2022 was as high as 35.3% of total NO_x emissions. The passenger car sector is also important, accounting for more than 18.4% of total NO_x emissions in 2022. One of the priorities for ambient air protection highlighted by the Environmental Air Protection Act is the reduction of vehicle emissions by reducing the use of internal combustion engine vehicles and increasing the use of electric vehicles.

The Action Plan for the Development of Electric Vehicle Use and Charging Infrastructure aims to set out measures and actions to increase the use of electric vehicles and to ensure the effective development of electric vehicle charging infrastructure in Lithuania in the period 2022–2030. The number of electric vehicles is projected to reach at least 262,248 by 2030. The Plan will be updated

to consider the amendments to the Law on Alternative Fuels and the provisions of the EU Regulation (EU) 2023/1804 which entered into force.

The Roadmap for the development of hydrogen refuelling infrastructure and the promotion of hydrogen powered road vehicles in Lithuania aims to provide targets and measures to ensure the development of hydrogen refuelling infrastructure and to promote the use of hydrogen powered vehicles in Lithuania for the period 2023–2030. The objective is to have at least 10 hydrogen refuelling stations (public and private) on the territory of Lithuania by 2030 and at least 5% of all new vehicles purchased in the country to be hydrogen powered.

The policies and measures in the transport sector are listed in the table below.

Table 2-6. *Existing and planned policy measures in the transport sector by 2030*

No	Policy measures	Implementation period	Entities responsible for implementing the policy measure	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
			Existing policy measures		
T1-E	Promoting the purchase of electric vehicles	2017–2030	Ministry of Transport And Communications, Ministry of Finance, Ministry of Environment, Lazdijai Municipality	709.07	2,287.7
T2-E	Promoting the development of alternative fuels infrastructure and transport	2017–2030	Ministry of Transport And Communications, Ministry of Environment, Municipalities	1,029	2,414.2
T3-E	Electrification of railways and rolling stock	2016–2028	Ministry of Transport and Communications, JSC "Lietuvos geležinkeliai"	374.73	861.89
T5-E	Promoting less polluting vehicles	2020–2025	Ministry of Transport and Communications, Ministry of Environment	115.09	482.86
T6-E	Car registration fee	2020–2030	Ministry of Environment, Ministry of Transport and Communications, Ministry of Finance, JSC "Regitra"	152.89	127.21
T7-E	Abolition of the pollution tax allowance	2021–2021	Ministry of Environment, Ministry of Finance	34.70	144.55
T8-E	Electronic tolls in freight transport	2024–2030	Ministry of Transport and Communications, Ministry of Finance, Ministry of Environment, JSC "Via Lietuva"	344.59	1,342.67

T9-E	Reducing traffic congestion	2019–2030	Ministry of Transport and Communications, Ministry of Environment, Municipalities, Ministry of Social Security and Labour, State Labour Inspectorate, Public sector institutions	365.18	1,395.95
T10-E	Public awareness	2017–2030	Ministry of Environment, Ministry of Transport and Communications, Municipalities, Ministry of Energy, Ministry of Health, Ministry of Education, Science and Sport, Environmental Project Management Agency	135.02	319.39
T11-E	Renewal of vehicles through green procurement	2022–2030	Ministry of Transport and Communications, Ministry of Energy, Public Procurement Office, Ministry of the Interior	277.44	1,685.60
T12-E	Establishing low-emission zones in urban areas	2022–2030	Ministry of Transport and Communications, Municipalities	103.08	392.81
T13-E	Electric car charging infrastructure	2021–2030	Ministry of Transport and Communications, Ministry of Energy, Municipalities	547.21	1,625.18
T14-E	Environmentally friendly driving	2021–2030	Ministry of Transport and Communications	174.84	709.90
T15-E	Implementation of sustainable mobility measures	2016–2030	Municipalities	527.22	2,378.70
T16-E	Sustainable Mobility Fund	2023–2030	Ministry of Transport and Communications	**	**
T17-E	Railway development and infrastructure improvement projects	2024–2027	Ministry of Transport and Communications, JSC “Lietuvos geležinkeliai”	**	**
T18-E	Development of cycling infrastructure	2022–2030	Ministry of Transport and Communications, Ministry of Environment, Municipalities	96	366.3
T19-E	Vehicle emission monitoring system	2023–2030	Ministry of Environment, Ministry of Transport and Communications, State Enterprise Lithuanian Road	10	38.16

			Directorate, Lithuanian Transport Safety Administration, Municipalities		
T23-E	Promoting sustainable mobility	2023–2030	Ministry of Transport and Communications, JSC “Lietuvos geležinkeliai”, Municipalities	134.56	551.21
T26-E	Developing sustainable airport infrastructure	2023–2025	JSC “Lietuvos oro uostai”	6.16	4
T27-E	Law on excise duties	2025	Ministry of Finance	769.03	7,435.06
T28-E	Implementation of ETS2	2024	Ministry of Environment	283.14	2,584.74
T29-E	Klaipėda State Seaport Authority fleet renewal	2025–2026	Klaipėda State Seaport Authority	1.8	6.87
T30-E	Use of alternative fuels in the Port of Klaipėda	2023–2026	Klaipėda State Seaport Authority	5	***
T31-E	Developing electricity supply in the seaport	2023–2026	Klaipėda State Seaport Authority	**	**
T32-E	Promoting sustainable inland shipping	2024–2026	Ministry of Transport and Communications, State Enterprise Lithuanian Inland Waterways Authority	5	19.08
T33-E	Calculation of GHG and air pollution emissions	2023	Klaipėda State Seaport Authority	**	**
T34-E	Port Environmental Management System PERS	2023–2024	Klaipėda State Seaport Authority	2	7.63
		Planned policy measures			
T1-P	Promoting the purchase of electric cars	2026–2030	Ministry of Transport and Communications	98.37	346.57
T2-P	Promoting the development of alternative fuels infrastructure and transport	2024–2030	Ministry of Transport and Communications, Municipalities, Ministry of Energy, National Energy Regulatory Council	333.93	732.49
T4-P	Promoting intermodal transport	2022–2030	Ministry of Transport and Communications, JSC „Lietuvos geležinkeliai”	279.75	1,097.48
T20-P	Restrictions on polluting vehicles	2024–2025	Ministry of Environment, Ministry of Transport and Communications, Ministry of the Interior, JSC “Regitra”	**	**
T21-P	Modernising trains	2024–2030	Ministry of Transport and Communications,	5.00	19.08

			JSC „Lietuvos geležinkeliai”		
T22-P	Encouraging the purchase of bicycles and motorised bicycles	2025–2030	Ministry of Transport and Communications, Ministry of Environment	3.14	3.08
T23-P	Promoting sustainable mobility	2024–2030	Ministry of Transport and Communications, Ministry of Education, Science and Sport, Ministry of Environment, Municipalities	18.00	68.69
T24-P	Promoting sustainable inland shipping	2024–2030	Ministry of Transport and Communications, State Enterprise Lithuanian Inland Waterways Authority, Ministry of Environment, Municipalities, JSC “Smiltynės perkėla”	114.50	422.58
T25-P	Developing electricity supply in the seaport	2024–2030	Ministry of Transport and Communications, Ministry of Energy, Klaipėda State Seaport Authority	**	45.16
T26-P	Developing sustainable airport infrastructure	2024–2030	JSC “Lietuvos oro uostai”	0.82	***
T27-P	Law on excise duties	2025	Ministry of Environment	**	**

** *– The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

*** *– The measure implements renewable energy solutions that do not directly contribute to fuel and energy savings but ensure the deployment of clean technologies.*

Descriptions of the policy measures:

T1-E. Promoting the purchase of electric cars. This measure aims to reduce pollution in the transport sector by encouraging the acquisition and use of electric vehicles (EVs) through a series of measures planned for 2022–2030. From 2022 to 2027, subsidies are provided for individuals to purchase new or used (up to 4 years old) passenger EVs and for businesses to acquire new passenger (M1) and commercial (N1) EVs. Between 2023 and 2026, the public sector receives support to adopt zero-emission vehicles, such as electric or hydrogen-powered cars. In rural areas, measures are implemented from 2022 to 2030 to replace polluting public transport with EVs, introduce charging infrastructure, and enable on-demand services like social taxis. Starting in 2030, registration of fossil-fuel-powered N1 vehicles will be banned, except for those using alternative fuels. Additional initiatives include tax exemptions for commercial EVs and hydrogen-powered vehicles (2023–2030), with a 75% road tax reduction beginning in 2026. From 2023, VAT deductions are allowed for EV purchases up to €50,000 (including VAT). Notably, during 2021–2022, over 2,600 EVs were purchased with financial incentives provided to individuals and businesses.

T2-E. Promoting alternative fuels infrastructure and vehicles. The measure includes: 1) Promoting the acquisition of clean public transport vehicles (2017–2023). Financial incentives for the purchase of alternative fuel buses (electric or natural gas) in categories M2 or M3. Under the measure, 189 public transport vehicles have been purchased in Lithuania, including 90 trolleybuses, 51 electric buses and 48 buses powered by compressed natural gas, through projects financed by EU funds from 2014–2020 and national funds. 2) Development of a zero-emission urban and suburban public transport fleet and the necessary charging/refuelling infrastructure (2024–2029). Financial incentives for the purchase of fully clean (electric or hydrogen) M2 or M3 buses and the development of the necessary charging/refuelling infrastructure; 3) Promotion of the production/conversion of electric public transport vehicles (2024–2026). Financial incentives to promote the production of clean (electric) M2 or M3 buses and the conversion of polluting fossil fuel buses to clean (electric) M2 or M3 buses; 4) Establishment/development of charging/refuelling infrastructure for alternative fuels (electricity, biogas and hydrogen) (2023–2027). Financial incentives for the creation and development of public compressed biogas refuelling points, public hydrogen refuelling points, public charging infrastructure for heavy electric transport; 5) Encouraging the purchase of heavy duty (categories N2, M2, N3 and M3) vehicles powered by alternative fuels (2024–2030). Financial incentives for the purchase of clean and zero-emission vehicles powered by electricity, hydrogen or biogas produced from Directive (EU) 2018/2001 (RED II) compliant raw materials; 6) National legal and regulatory measures for the development of alternative fuels infrastructure (2023–2030). National development targets and measures to promote change are identified; 6) EU legal and regulatory framework for the development of alternative fuels infrastructure (2023–2030). Requirements and scopes for the development of publicly accessible charging/refuelling infrastructure at identified locations.

T3-E. Electrification of railways and rolling stock. The measure includes 1) Railway Electrification 2016–2023 and 2) Railway Electrification 2022–2027. It foresees the renewal, improvement and extension of the 1520 mm gauge railway infrastructure (including the construction and electrification of second tracks) in transport corridor IX B, the electrification of the Vilnius node, the electrification of the Kaišiadorys-Radviliškis, Radviliškis-Klaipėda sections (total of about 420 km), and the electrification of the electrified Rail Baltica railway line in Lithuania (394 km); 3) Acquisition of trains powered by alternative energy sources to provide public services (2024–2028). Replacement of non-compliant diesel trains with modern, environmentally friendly electric and battery trains for passenger transport; 4) Installation of charging infrastructure for battery trains (2023–2026). Installation of charging bays for charging battery trains on non-electrified sections of part of the routes; 5) Acquisition of electric locomotives (2024–2028). Electric locomotives will be used on the electrified section to transport freight instead of diesel locomotives.

T5-E. Promoting less polluting mobility modes. The measure includes financial incentives for natural persons who have surrendered a polluting passenger car that has been in service in Lithuania for a specified period of time as an end-of-life vehicle: 1) Compensatory allowance for the purchase of a low-emission car; 2) Compensatory allowances for the purchase of alternative means of transport such as bicycles, e-scooters, e-bikes, public transport passes, or ridesharing; 3) Compensatory allowances to the poor for the purchase of a less polluting car (2020–2025).

T6-E. Car registration fee. The Law on Registration Tax on Motor Vehicles of the Republic of Lithuania establishes that from 1 July 2020, registration of passenger cars and light goods vehicles (M1 and N1 categories) will be subject to a registration fee, depending on the type of fuel and their combinations, and when the CO_2 emissions exceed more than 130 g/km (2020–2030).

T7-E. Abolition of the pollution tax allowance. The exemption from the tax on environmental pollution from mobile sources for individuals engaged in an individual activity, as defined in the Personal Income Tax Act, and using personal vehicles in their activities is abolished (2021).

T8-E. Electronic tolls in freight transport. The measure includes: 1) Implementation of E-tolling for freight transport (2026–2030). Introduction of a new road charging system E-tolling, where the charge is not based on time but on distance travelled, encouraging vehicle operators and users to move away from empty mileage, consolidate shipments, optimise routes, use environmentally friendly vehicles, and purchase less polluting (higher EURO class) vehicles; 2) Road charging based on Euro-classes of vehicles and concession for the least polluting vehicles (2024–2030). The range of tariff levels will be linked to the EURO class of vehicles. The highest Euro class will also include non-polluting vehicles and will be subject to the lowest rate.

T9-E. Traffic congestion reduction. The measure includes: 1) Changes in traffic organisation through traffic planning measures (flow distribution, peak hour traffic restrictions) and/or smart traffic control technology (smart traffic lights, crossings, etc.) (2021–2030); 2) Recommendations to municipalities covering spatial planning solutions contributing to efficient traffic organisation (optimal location of public transport recharging points, development of commercial areas in line with traffic volume, etc.) 3) Educating and informing employers and employees on the use of flexible working time options (remote work, flexible start and end times, additional days off, etc.) to reduce the number of journeys to and from work (2019–2030).

T10-E. Public awareness. The aim of the measure is to inform and educate the public to encourage the use of cleaner vehicles and other alternatives to the car. The measure includes: 1) Training, publicity, presentations, advertising, etc. in kindergartens, schools, universities, for citizens, public, municipal and private companies and organisations, etc. (2017–2030); 2) Organising hackathons and funding winning initiatives that influence the behaviour of groups of the public (2022–2030); 3) Conducting an electro-mobility communication campaign and a market study (2023–2024).

T11-E. Renewal of vehicles through green procurement. The measure implements a change in the legislative framework to increase the use of clean vehicles and reduce the number of conventionally fuelled vehicles in line with the necessary public procurement targets (2022–2030).

T12-E. Establishing low-emission zones in urban areas. Under the Alternative Fuels Act, low-emission zones must be established in cities by 1 January 2025. The Ministry of Transport and Communications has drawn up guidelines for the establishment of low emission zones in 2023. Municipal authorities have to identify low emission zones in cities with resort or spa status or more than 50,000 inhabitants and prepare projects for their establishment (2022–2030).

T13-E. Electric car charging infrastructure. The measure includes: 1) Development of publicly accessible charging infrastructure (2023–2029). Financial incentives for the acquisition/installation of publicly accessible charging points in municipalities according to prepared plans and on private initiative, alongside public roads on private initiative; 2) Development of public charging infrastructure (for light and heavy transport) (2024–2026). Financial incentives for the development of publicly accessible charging infrastructure alongside the trans-European transport network roads and in other locations as required by the EU; 3) Development of primary public charging infrastructure for electric vehicles (2021–2022). With financial incentives, the first 160 charging bays will be installed in municipalities and on major national roads. 4) Development of private EV charging infrastructure (2022–2027). Financial incentives for the acquisition/installation of private charging bays in locations where EVs spend most of their time parked: private properties, apartment

blocks, courtyards, parking lots, workplaces, etc. Private charging infrastructure is promoted by providing smart charging features; 5) Legal and regulatory incentives to develop charging infrastructure: Adoption of an action plan for the development of electro-mobility; level playing field for operators to install and develop publicly accessible charging points alongside national roads; changes to road traffic rules to increase the attractiveness of electric vehicles; Compensation for connection of charging infrastructure to the electricity grid, simplification of conditions for connection to the electricity grid, implementation of separate metering of electricity per consumption facility, ensuring separate metering of charging of electric vehicles, possibility to participate in the fuel from renewable energy sources accounting system, obligations to ensure publicly available charging infrastructure capacity per electric vehicle (2021–2030); 6) EU legal and regulatory obligations for the development of charging infrastructure under the Regulation 2023/1804/EU on the deployment of alternative fuels infrastructure, which foresees the provision of public charging infrastructure for light and heavy vehicles on the territory of the EU Member States by 31 December 2030 at the latest, in accordance with the requirements set out in the Regulation (capacity, distances, etc.), so as to allow the seamless movement of electric cars and trucks across the EU (2023–2030).

T14-E. Environmentally friendly driving. Driving schools have already included eco-driving training in their driver training programmes since 2010, and JSC "Regitra" has been successfully testing the knowledge and skills of economical and eco-driving in its driving tests since 2014. As a result, new drivers are familiar with the principles of eco-driving. However, those who have previously learned to drive may not have the knowledge of eco-driving, and it is therefore planned to develop a publicly accessible eLearning platform/computer-based eLearning programme for economical and eco-driving in cyberspace, in order to enable every member of the public to benefit from information and communication technology tools and to receive high quality and effective training in economical and eco-driving (2021–2030).

T15-E. Implementation of sustainable mobility measures. The measure is addressed to municipalities and includes: 1) The implementation of Sustainable Urban Mobility Plans (SUMPs) (2018–2022). Measures for the deployment and development of intelligent transport systems in the city, the adaptation of city streets and other transport infrastructure to public transport needs, the deployment of cable transport, the adaptation of urban transport infrastructure for people with special needs, public-private transport interoperability systems, the deployment and development of bicycle infrastructures and systems, the adaptation of local public transport (urban and suburban) to the transport of cyclists and people with special needs, the introduction and expansion of public transport safety equipment are funded; 2) The preparation of SUMPs (2016–2023). 18 municipalities have developed the SUMP with EU funds from 2014–2020; 3) Further implementation of the SUMP (2021–2027). Implementation of measures to promote walking, cycling, public transport and the use of alternative fuels in 18 municipalities; 4) Reducing the attractiveness of urban car use (2021–2030). Reducing the number of parking spaces and/or increasing the cost of parking.

T16-E. Sustainable Mobility Fund. The Fund was created to implement the provisions of the Law on Alternative Fuels of the Republic of Lithuania. The Fund will be used to finance measures for urban sustainable mobility plans, to promote the use of alternative fuel vehicles, to develop and expand alternative fuels and transport infrastructure, to install restrictions on the use of internal combustion engine vehicles in cities, to finance the conversion of internal combustion engine vehicles to alternative fuel vehicles, and to finance the implementation of measures for the reduction of ambient air pollution (2023–2030).

T17-E. Railway development and infrastructure improvement projects. The measure aims at adapting maintenance activities and infrastructure to the new electric passenger trains: upgrading and creating a passenger train maintenance and repair facility to service existing, newly procured electric and battery-powered passenger rolling stock; introducing renewable and green solutions for the maintenance and repair of passenger rolling stock; and improving the health and safety conditions of the staff involved in the maintenance of passenger rolling stock (2024–2027).

T18-E. Development of cycling infrastructure. The measure aims to plan and build cycling infrastructure in urban, suburban and rural areas to reduce the volume of car traffic in urban and suburban areas (2022–2030).

T19-E. Vehicle emission monitoring system. The aim of the measure is to reduce the use of non-roadworthy vehicles, testing and deployment of a portable remote monitoring system for vehicle emissions: remote measurement of vehicle emissions on the road using portable equipment (educational/informative pilot project); decision on the application of the remote monitoring system after an analytical assessment; deployment of a remote monitoring system and/or reinforcement of technical roadside inspections of road vehicles (2023–2030).

T23-E. Promoting sustainable mobility. The measure includes: 1) Making public transport more attractive by making fares lower/free, allowing faster travel, convenient transfers, and access to electric car sharing, bike rental (2023–2030); 2) Implementation of JSC "Lietuvos geležinkeliai" smart ticketing system with new ticketing channels, loyalty system based on CO_2 consumption history and adapted for persons with disabilities (2024–2030); 3) Harmonisation of passenger train and public road passenger transport timetables, setting up of places for electric car sharing, bicycle rental services (2023–2030); 4) Convenient interchanges at inland waterway and maritime passenger ports to public road transport, if compatible, rail transport, use of electric car sharing, bicycle rental facilities (2023–2030); 5) Increasing the attractiveness of public transport by allowing faster movement along defined routes (2023–2030); 6) Keep public transport fares under constant review or at a discount (2023–2030); 7) Revision of bus stop layout, routes and timetables, with inter-coordination between urban/suburban/intercity and long-distance routes (2023–2030).

T26-E. Developing sustainable airport infrastructure. The measure includes: 1) Provision of electricity supply to aircraft parked at Vilnius, Kaunas and Palanga airports (2024–2030); 2) installation of charging bays for electric vehicles in the territories of Vilnius and Kaunas airports' aerodromes (2023–2025).

T27-E. Law on excise duties. From 2024, the excise duty reductions (or their scope) for heating gas oil, coal, coke, lignite, LPG for heating (bottled and unbottled in household gas cylinders) are phased out or reduced, and the excise duty rates for gas oil, coal, coke and lignite are gradually increased over the period from 2024–2026. Excise duties are introduced on a new fuel, peat for heating purposes, and gradually increased (to prevent this polluting fuel from becoming an alternative to coal) (from 2024). From 2025, the amendments to the Excise Duty Law will add to the excise duty rates on petrol, kerosene, diesel, gas oil for heating, petroleum gas and gaseous hydrocarbons (except for non-business heating), coal, coke, lignite, fuel oil, and orimulsion a CO_2 component proportional to the CO_2 emissions of the fuel type in relation to calorific value, which will be increased proportionately each year from 2025 to 2030 (from 2025). In addition (to the CO_2 component of €60/1000 l already introduced from 2025), a safety component will be introduced from 2025 for gas oils for agricultural use, which will amount to €25/1000 l in 2025 and €50/1000 l in the period 2026–2030.

T28-E. Implementation of ETS2. The ETS2 system is levied on fuel suppliers who supply fossil fuels or fuels to the market. The amount of fuel supplied is converted into tonnes of CO_2 and for each tonne of CO_2, fuel suppliers will have to pay with allowances purchased on the market. The aim is to accelerate the phase-out of fossil fuels and the increased use of renewable energy sources (from 2027). A public awareness campaign will also be carried out to raise the awareness of the population and small businesses about the inclusion of the heating and transport sectors in the ETS, and the implications for fuel prices and the possibilities to change their heating and transport choices.

T29-E. Klaipėda State Seaport Authority fleet renewal. The measure includes: 1) The acquisition of a waste collection vessel with an electric propulsion system (and the possibility of deploying hydrogen technology) (2025–2026); 2) The acquisition of new pilot boats with hybrid propulsion (2 units) to replace the current fossil (diesel) boats. The planned introduction of electric motors, power accumulators (energy storage system) and other innovative measures on the pilot boats will result in a reduction of diesel fuel consumption by around 30% compared to the current consumption of pilot boats (2025–2026), depending on the intensity of work.

T30-E. Use of alternative fuels in the Port of Klaipėda. Installation of public hydrogen refuelling points: maritime, land transport and/or mobile (2023–2026).

T31-E. Developing electricity supply in the seaport. Installation of a power supply system for ro-ro and ro-pax vessels at the Port of Klaipėda. Central Klaipėda Terminal is planning installations at three existing berths and Klaipėda Container Terminal is planning installations at one existing berth. Shore power connections will allow the ferries to switch off their auxiliary engines and supply the ships with electricity during their stay in port, while the energy needed for the hotels will also be supplied from the shore power grid (2023–2026).

T32-E. Promoting sustainable inland shipping. The measure aims at renewing the existing fleet for the management of inland waterways through the acquisition of an electric pusher craft, a non-self-propelled barge and an electric crane (2024–2026).

T33-E. Calculation of GHG and air pollution emissions. The emissions to the ambient air from Klaipėda port activities, shipping and port transport in 2022 are assessed and recommendations (measures) are developed to reduce them. Air pollutants and GHG emissions from different types of ships calling at the port and operating permanently in the port, port companies, road and rail transport of cargo through Klaipėda port were assessed separately (2023).

T34-E. Port Environmental Management System PERS. A Port Environmental Review System (PERS), specific to the port sector, is in place to ensure effective management of the port environment. PERS is based on the policy recommendations of the European Seaports Organisation, a scheme specifically designed to help port authorities to achieve regulatory compliance and ensure the sustainable development of port activities, protect the environment, and address climate issues (2023–2025).

T1-P. Promoting the purchase of electric cars. Financial support measures for purchasing EVs and developing or upgrading charging infrastructure will remain in place until EVs constitute at least 10% of all registered passenger cars in the country. For individuals, funding supports the acquisition of new and used M1 category electric cars. For businesses, funding is available for purchasing new M1 and N1 categories electric cars, with specific measures planned for 2026–2030.

T2-P. Promoting the development of alternative fuels infrastructure and transport. The measure includes: 1) Upgrading urban and suburban public transport by promoting the use of vehicles powered by alternative fuels (electricity and hydrogen) (2027–2030); 2) Promotion of the development of

charging and refuelling infrastructure for alternative fuels (electricity and hydrogen) (2026–2030); 3) Promotion of the use of heavy duty vehicles of categories N2, M2, N3 and M3 powered by alternative fuels (2025–2030); 4) Digital solutions to optimise the flow of freight and to reduce empty mileage (2024–2030); 5) Assessment of the technical feasibility of connecting charging infrastructure to the electricity transmission grid and review of the pricing of the electricity transmission service associated with charging infrastructure (2026–2030).

T4-P. Promoting intermodal transport. The measure includes: 1) Promotion of intermodal transport on the 1,435 mm network in the Italian direction (2023–2030); 2) Promotion of intermodal transport on the 1,435 mm network (2022–2030); 3) Technical development of the intermodal terminals of Vilnius and Kaunas (2022–2025). The aim is to adapt the terminals to semi-trailer handling and to higher container flows; 4) Adjusting the tax base to favour the least polluting mode of transport (e.g. increase of road tolls for trucks, compensation of railway infrastructure tax, etc.) and promotion of less polluting freight transport (2025–2030); 5) Feasibility study on the transfer of heavy goods transported through Lithuania to railways (2024–2030). To transfer freight that has reached the Lithuanian border onto rails where possible and to continue transporting it by rail, it is necessary to determine the feasibility and effectiveness of such a measure by means of a feasibility study; 6) Promoting intermodal transport on the 1520 mm network. The measure has been implemented by adapting flat wagons of a defined model (manufacture and installation of reusable semi-trailer attachments).

T20-P. Restrictions on polluting vehicles. To limit the registration of polluting road vehicles through the vehicle registration tax: a) to carry out an assessment of the composition of the fleet of M1, N1 vehicles registered in Lithuania, analysis of the compulsory roadworthiness test data and other relevant information and data, with a view to reviewing the Law on Motor Vehicle Registration Tax and to significantly reduce the attractiveness of the purchase of polluting (Euro 4 and lower emission classes) road vehicles; b) to make amendments to the Law on Motor Vehicle Registration Tax (2024–2025).

T21-P. Modernising trains. Upgrading of three existing two-car Škoda EJ575 electric trains to battery-electric trains. With the Škoda EJ575 electric trains no longer running on the Vilnius – Minsk route and due to the limited electrification of the railway network in Lithuania. Converting the trains to battery-electric could allow them to run on non-electrified routes and replace some diesel trains (2024–2030).

T22-P. Encouraging the purchase of bicycles and motorised bicycles. The financial incentive would apply to the purchase of bicycles and motorised bicycles. There are various options for financial incentives, such as: compensation, tax incentives for businesses, etc. (2025–2030).

T23-P. Promoting sustainable mobility. The measure includes: 1) a series of lectures on sustainable mobility to encourage the public to change their travel habits and to use the greenest possible travel modes (2024–2030); 2) financial incentives for the development and deployment of integrated ticketing systems for public transport, which would make it easier for passengers to plan their travels and to pay for their travels by different modes of public transport (2024–2026); 3) development of a sustainable mobility mobile application aimed at changing the internal attitudes of transport users through feedback on travel distance, time, CO_2 footprint and energy consumption and suggestions for more sustainable alternatives (2024–2030).

T24-P. Promoting sustainable inland shipping. The measure includes: 1) The acquisition of new cargo vessels and barges to enable a shift of some cargo from polluting road transport to less polluting

or less polluting inland waterway transport; 2) the replacement of the fuel used by the ferries operating on the Klaipėda – Kuršių Nerija route with less polluting or non-polluting fuel, and the upgrading of the ferry infrastructure (to accommodate the needs of the electrically powered ferries); 3) Replacement of power plants on board inland waterway vessels with less polluting or non-polluting ones; 4) Increasing the passenger flow by water and consequently reducing the passenger flow by road and aiming at new vessels powered by LNG or RES; 5) Developing and/or upgrading the infrastructure of inland waterways, including harbours and marinas (2024–2030).

T25-P. Developing electricity supply in the seaport. The measure includes: 1) The installation of an electricity supply system for ships at berth in the Port of Klaipėda; 2) The provision of a minimum electricity supply infrastructure in the port for maritime containers and passenger ships (2024–2030).

T26-P. Developing sustainable airport infrastructure. The measure includes: 1) The deployment of sustainable aviation fuel supply infrastructure; 2) The upgrading of airport infrastructure by providing new or adapting existing aircraft parking facilities according to the criteria required to support hydrogen and/or electric aircraft (2024–2030).

T27-P. Law on excise duties. Amendment of the excise duty law to introduce a reduction for biogas. The purpose is to provide that biogas, as defined in the Law on Renewable Energy of the Republic of Lithuania, is exempted from the excise duty rates for petroleum gas and gaseous hydrocarbons (excluding natural gas) as laid down in Article 39 of the Law on Excise Duty. Article 581 should also be supplemented to provide that biogas is also exempted from excise duties on natural gas. This will enable the promotion of biogas production in the Republic of Lithuania with a view to increasing its share in the natural gas supplied to consumers and thus reducing the impact on climate change (from 2025).

Promotion of the RES use in the transport sector

The development of RES in the transport sector is being carried out in line with the targets set out in national legislation to ensure that at least 29% of the transport sector's fuel and energy mix is made up of fuels from renewable energy sources. One of the key principles of decarbonisation of the transport sector is the effective integration of alternative fuels. The aim is to use a wide range of fuels in the Lithuanian transport sector, including biofuels produced from food and/or feed crops, advanced biofuels produced from waste and residues, biomethane, electricity from RES and non-biological fuels from RES. The measures already adopted aim to ensure that the combined share of biogas and non-biological gaseous fuels from renewable energy sources in the final energy consumption of the transport sector is at least 5.2% in 2030, and that the number of electric vehicles in the country reaches 240,000. In the transport sector, the aim is to significantly reduce the use of fossil fuels, and the National Climate Change Management Agenda (NCCMV) will aim to achieve a 50% reduction in the use of fossil fuels in road transport by 2035.

The development of biomethane and advanced biofuel production capacity and the adaptation of the regulatory environment to exploit the country's bio-waste and residue potential is a major focus. The aim is to exploit the potential of biofuels produced in Lithuania, subject to restrictions on the use of biofuels produced from food and/or feed crops.

Since 2022, Lithuania has had a transport sector energy credit system in place, where fuel suppliers register the volumes of fuel supplied to the domestic market and the accounting units, they are given

for supplying RES fuels are used for the implementation of mandatory obligations. The system integrates the different types of RES fuels, thus promoting technological neutrality.

The policies and measures to increase the share of RES in the transport sector are listed in the table below.

Table 2-7. *Existing and planned policy measures for promotion the RES use in the transport sector by 2030*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
AEI10-E	Investment support for the installation of biomethane production and biogas purification plants	2020–2030	Ministry of the Economy and Innovation, Ministry of Agriculture, Ministry of Environment	860.46	0.29
AEI11-E	Obligation on the use of RES for operators of natural gas filling stations supplying natural gas to the transport sector	2025–2030	Ministry of Energy, National Energy Regulatory Counsil	**	0
AEI12-E	Mandatory blending of biofuels into mineral fuels	2022–2030	Ministry of Energy	1,372.60	1.78
AEI13-E	Investment support for second-generation biofuel production facilities	2023–2026	Ministry of Energy	***	0.09
AEI14-E	Integration of charging point operators into the fuel from renewable energy sources accounting system.	2023–2028	Ministry of Energy	**	0
AEI15-E	Developing green hydrogen production	2023–2028	Ministry of Energy	8.37	**
T13.4-E	Private charging infrastructure development	2022–2027	Ministry of Transport and Communications	142.7	0.00
		Planned policy measures			
AEI10-P	Investment support for the installation of biomethane production and biogas purification plants	2026–2030	Ministry of Energy, Ministry of Agriculture, Ministry of Environment	50.85	0.18
AEI15-P	Developing green hydrogen production	2024–2030	Ministry of Energy, JSC “Amber grid”	**	**
AEI23-P	Disseminating information on biofuels sold at filling stations	2025–2030	Ministry of Energy	**	**
AEI24-P	Regulatory changes for the establishment of a biomethane gas access point system	2024–2030	Ministry of Energy	**	**
AEI25-P	Implementation of CCS/CCUS technologies	2024–2030	Ministry of the Economy and Innovation, Ministry of Energy, Ministry of	***	**

	Environment, Ministry of Agriculture, Ministry of Transport and Communications

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

**** – The measure implements renewable energy solutions that do not directly contribute to fuel and energy savings but ensure the deployment of clean technologies.*

Descriptions of the policy measures:

AEI10-E. Investment support for the installation of biomethane production and biogas purification plants. The measure aims to finance biomethane production facilities, including biogas treatment plants. The aim is to create a production capacity of 1,400 GWh of biomethane gas production by 2030. The construction of a gas pipeline to the common gas grid is not financed (2020–2030).

AEI11-E. Obligation on the use of RES for operators of natural gas filling stations supplying natural gas to the transport sector. To ensure the parallelism between the demand and supply of biomethane gas produced, and considering the projected increase in the consumption of natural gas in the transport sector, entities supplying natural gas for direct consumption in the transport sector are obliged to supply a fixed and progressively increasing amount of gas from renewable energy sources (2025–2030).

AEI12-E. Mandatory blending of biofuels into mineral fuels. Fuel outlets must sell petrol complying with Lithuanian or European standards, containing at least 6.6% biofuels based on the total energy value of the blend of fuels and biofuels (blending into A98-grade petrol is not compulsory), and diesel fuels, containing at least 6.2% biofuels based on the total energy value of the blend of fuels and biofuels (2022–2030).

AEI13-E. Investment support for second-generation biofuel production facilities. By providing investment aid to biofuel producers, Lithuania is expected to produce at least 12.4 ktoe of second-generation biofuels produced from waste and/or residues. The investment aid would be granted for new production facilities to be set up next to existing biofuel production facilities or to create a production infrastructure from scratch. The intensity of the investment support would not exceed 50% depending on the size of the enterprise (2023–2026).

AEI14-E. Integration of charging point operators into the fuel from renewable energy sources accounting system. Charging point operators would be able to receive renewable energy sources accounting system units for the electricity supplied to electric vehicles from RES, which could be traded with oil fuel suppliers. A clear control system based on smart metering must be put in place to ensure accurate accounting of RES electricity. The integration of advancing accounting device technologies enabling the accounting of multiple electricity consumption devices at a single point of consumption would be extended to private entities in the renewable energy sources accounting system (2023–2028).

AEI15-E. Developing green hydrogen production. The measure includes: 1) Developing green hydrogen production capacity in the transport sector. New green hydrogen (hydrogen produced by electrolysis using electricity from RES) production capacity will be developed for use in the transport sector to replace conventional fossil fuels and reduce GHG emissions (2023–2026). 2) Developing green hydrogen capacity (I). New green hydrogen production capacity (65 MW) will be developed in various sectors to replace the use of polluting fossil fuels (2023–2028). 3) Developing green hydrogen

capacity (II). The plan is to finance the flexible development of green hydrogen production capacity (21 MW) to replace fossil fuels in various sectors, to help balance the electricity system and to produce hydrogen derivatives. The measure will contribute to increasing the flexibility capacity of the electricity system (2024–2030).

T13.4-E. Private charging infrastructure development. Development of private EV charging infrastructure (2022–2027). Financial incentives for the acquisition/installation of private charging bays in locations where EVs spend most of their time parked: private properties, apartment blocks, courtyards, parking lots, workplaces, etc. Private charging infrastructure is promoted by providing smart charging features.

AEI10-P. Investment support for the installation of biomethane production and biogas purification plants. The measure aims to develop additional biomethane production capacity. The EU and Lithuanian regulatory environment and planned requirements for the management of agricultural waste and food waste are becoming increasingly stringent, resulting in an increasing amount of bio-based raw materials that can be used for energy production. Demand for biomethane is emerging not only in the transport sector, but also in other sectors such as industry, heating and agriculture. The RePower EU initiative foresees that EU biomethane production is set to increase to 35 billion cubic metres by 2030, and in this context, biomethane production capacity and deployment infrastructure needs to be proactively increased. The aim is to provide at least 600 GWh of additional biomethane production capacity, which together with the implementation of the AEI10-E measure would result in 2 TWh of biomethane production in 2030 (2026–2030).

AEI15-P. Developing green hydrogen production. The measure includes: 1) Developing green hydrogen capacity (III). The anticipated need, in line with Lithuania's hydrogen vision, to ensure flexible development of green hydrogen production, using the hydrogen produced to reduce GHG emissions, balance the electricity system and produce hydrogen derivatives. The planned electrolysis plant has a capacity of 996 MW (2024–2030). 2) Assessment of the development of hydrogen infrastructure. A feasibility study will be carried out together with the gas transmission system operators of neighbouring countries for the construction of a European hydrogen corridor linking Finland with Germany (Nordic-Baltic Hydrogen Corridor) (2024–2026).

AEI23-P. Disseminating information on biofuels sold at filling stations. For consumer information purposes, it is proposed to impose an obligation on service station operators to publish information on the raw materials used in the production of biofuels in the fuel mix sold at service stations and their country of origin. The measure is of a regulatory nature and would therefore require legislative amendments (2025–2030).

AEI24-P. Regulatory changes for the establishment of a biomethane gas access point system. This measure aims to enable producers located far from the gas grid to feed biomethane into the gas grid without directly connecting the production facility. The measure is necessary because feeding biomethane into the gas grid is a complex and costly process that requires the construction of a gas pipeline to the biomethane production facility and is not an efficient and cost-effective process for remote production. Gas injection access points would allow some biomethane producers to supply gas to the gas grid offline by transporting the produced biomethane to the gas injection point by gas carriers. This measure would create the regulatory environment to enable the injection of gas and establish the authorities responsible for control and supervision (2024–2030).

AEI25-P. Implementation of CCS/CCUS technologies. The measure includes: 1) Implementation of carbon capture technologies, with priority given to biogenic carbon capture. This action promotes the

capture of biogenic and atmospheric CO_2, which can then be used to produce synthetic energy products (e-methane and e-methanol) or transferred for permanent storage with negative emissions (2024–2050); 2) Establishment of carbon dioxide transport infrastructure. This activity promotes the greening of national and regional industries, focusing on hard-to-decarbonise industries, through CO_2 capture and transport. An open access infrastructure is being developed to allow all CO_2 emitters, without exception, to join the project. The infrastructure will be designed for both the export of fossil ("grey") CO_2 and the import of biogenic ("green") CO_2, which will be used by local actors as feedstock (e.g. to produce synthetic fuel) (2024–2030). Creating and developing a market for carbon dioxide utilisation. Establishing standards and market conditions for synthetic products made with H2 and CO_2 (2025–2030); 4) Developing a CO_2 monitoring system. The aim is to develop a system to accurately assess the efficiency and effectiveness of carbon capture, including the capture of carbon dioxide by origin. One example is a voluntary certification scheme for CO_2 reduction, replacing the ETS (2025–2030); 5) Develop support mechanisms for carbon capture, transport and use in the production of synthetic green fuels. This activity aims to develop support mechanisms for carbon capture, transport and use in the production of synthetic green fuels. Such incentive mechanisms should encourage the use of biogenic carbon dioxide in the production of high value-added products such as synthetic green fuels and other chemicals (2025–2030).

2.4.3. Industrial processes and product use

The policies and measures in the industrial processes and product use (IPPU) sector are based on a few main principles which are required to reach environmental targets. Firstly, the amount of its waste should be reduced, the production more sustainable, natural and energy resources used efficiently. Secondary, raw materials should be processed, the multi-use packaging and materials produced and utilized, waste (especially hazardous) securely managed, and equipment needed for environmental protection should be manufactured.

The **Programme for Investment Incentives and Industry development for 2014–2020** was approved on 17 of September 2014 by the Resolution No 986 of the Government. In this programme an objective to encourage enterprises to use recourses and energy more efficiently as well as use of RES is set. It is planned to implement energy efficiency measures and to reduce energy use in manufacturing industry from 222.9 (in 2012) to 182.9 (in 2020) kg of oil equivalent (for creation of 1,000 EUR value added). Additionally, Ministry of Economy and Innovation prepared a study on "The potential of energy use efficiency increase in industry enterprises and determination of measures which encourage the use of different types of energy" in 2015. The aim of this study was to identify measures and main drives which encourage increasing energy efficiency in industry and to use different types of energy as well as help to identify the main implementation mechanisms and provide recommendations how to implement the proposed measures. Implementation of the Programme is financed from the EU structural funds.

The Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and the Directive 2008/1/EC of the European Parliament and of the Council of the 15th January 2008 concerning integrated pollution prevention and control (IPPC) are transposed into the national legislation.

Industrial enterprises, exceeding 50 MW must apply for the IPPC permit and enterprises below 50 MW must apply for the Pollution permit to ensure pollution prevention and to incentivise transfer to

cleaner technologies protecting the quality of environment. Natural resources must be used rationally and sparingly, energy use must be efficient, monitoring and control must be performed for the substances and raw materials, fuel and energy consumption in the processes of production. Less hazardous materials are promoted to use in the process of industrial activities.

The term "best available techniques" includes both the technology used and the way in which the installation is designed and maintained. The presented techniques are developed in the scale that allows implementation under economically and technically viable conditions and the techniques are most effective in achieving a high general level of protection of the environment as whole.

The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. ISO 14001:2015 and its supporting standards such as ISO 14006:2011 focus on environmental systems to achieve this. The other ISO 14000 standards focus on specific approaches such as audits, communications, labelling and life cycle analysis, as well as environmental challenges such as climate change. GHG emissions permits issued for the installations participating in the EU ETS are consistent part of the IPCC permits or Pollution permits.

In 2021 for the first time in Lithuania **the Roadmap for the transition of Lithuanian industry to a circular economy** was prepared. It analyses the reasons, sets the goals and directions, and proposes a set of policy measures that would encourage the transition of Lithuanian industry to a circular economy. In the findings of the analytical part noted that Lithuania's achievements are stable economic growth. However, this growth rested on the fundamentals of a linear economy. Meanwhile, climate change commitments force a new assessment of the situation and prospects – according to the analysis of metabolism, only 3.3%. Lithuania's economy is circular (the global circularity rate is 8.6%). The main priority areas of change for the transformation of Lithuanian industry towards a circular economy are the following: Ministry of Economy and Innovation leadership and the initiation and creation of a circular economy stakeholder cooperation platform; creating and/or improving the regulatory environment; ensuring the financial environment; creation of knowledge, competences and a common context among all stakeholders, ensuring the attraction, application of international methodologies and the initiation and support of competence centres; innovation, technology and infrastructure development; creation of a common circular economy monitoring system.

Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 was adopted in 2014. The main goals of this Regulation is to ensure a more cost-efficient contribution to achieving the EU's climate objectives by discouraging the use of F-gases with a high impact on the climate in favour of energy-efficient and safe alternatives, and further improving the containment and end-of-life treatment of products and equipment that contain F-gases; help to bring about a consensus on an international agreement to phase down hydrofluorocarbons (HFCs), the most relevant group of F-gases, under the Montreal Protocol.

It is aimed at cutting total EU emissions from F-gases by two thirds by 2030 compared to 2014 levels. It prohibits the placing of F-gases on the market in certain circumstances where alternatives are available. During 2018-2020, quotas for legally placing HFCs on the EU market were reduced to 63% of 2015 levels.

The Ministry of Environment has updated the existing national legislation and adopted new legislation in the area of fluorinated greenhouse gases ensuring the implementation of the requirements of the Regulation (EU) No 517/2014:

- The Order No D1-897 of the Minister of Environment ensuring the implementation of the requirements of the containment, use, recovery and destruction of the fluorinated greenhouse gases was adopted on 12 December 2016. This Order defines the functions of the national authorities ensuring the implementation of the requirements of the Regulation (EU) No 517/2014;
- The Order No D1-372 of the Minister of Environment establishes the Rules on the issuance of Certificates for the companies handling fluorinated greenhouse gases;
- The Order No D1-668 of the Minister of Environment establishing the training and attestation system for the employees engaged in the activities with the fluorinated greenhouse gases was prepared with the view to amend and updated the existing national legislation in this area to comply with the requirements on the Regulation (EU) No 517/2014, adopted on 20 October 2016.
- The Order No D1-12 of the Minister of Environment establishing the procedures for reporting on fluorinated greenhouse gases and ozone depleting substances, data collection and management, accounting of equipment and systems which contain these gases or materials was adopted on 10 January 2010 and was amended in 2016.
- The amendment to the Administrative Infringement Code establishing more stringent responsibilities for the breach of the requirements of handling fluorinated greenhouse gases was adopted in 2016.

In July 2017, the EU and its Member States committed to ratifying the Kigali Amendment to the Montreal Protocol, it came into force on 1 January 2019 and is a significant step forward in implementing the Paris Agreement by limiting the global production and use of hydro fluorocarbons (HFCs). Science suggests that an ambitious phase-down of HFCs alone could prevent up to 0.5 °C of global warming by the end of the century.

The Order No D1-973 of the Minister of Environment on the **Green procurement implementation measures for 2012–2015** adopted on 14 December 2011 and later amendments promoting the environmental management system in the manufacturing sectors as well as the strengthening ability of enterprises to organise green procurements.

In 2021 **Green procurement implementation measures plan 2021–2025** was approved by the Order No D1-448 of the Minister of Environment for the promoting the green public procurement application.

The Order No 620 of the Minister of Environment of 5 December 2002 (with later amendments in 2014) on **Limitation of emissions of volatile organic compounds** (hereinafter – VOC) was adopted. The aim of this Order is to reduce the direct and indirect impact of VOC emissions (released by paints, solvents, adhesives and other products) on environment, usually on the ambient air, and the potential risk on human health, by providing measures and procedures to be implemented in the activities referred to by this document, in case the activity exceeds the solvent consumption level prescribed in this normative document.

The policies and measures in the IPPU sector are presented in the table below.

Table 2-8. *Existing and planned policy measures in the IPPU sector by 2030*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
P1-E	Reducing fluorinated gases	2015–2032	Ministry of Environment	184.75	**
P2-E	Improving energy efficiency	2023–2030	Ministry of Energy, JSC "Baltpool", Ministry of the Economy and Innovation	795.44	6,545.70
P3-E	Incentives for investment and innovation	2018–2030	Ministry of Finance	**	**
P4-E	RES use in industry	2014–2027	Ministry of Energy, Ministry of the Economy and Innovation, Ministry of Environment	22.1	***
P5-E	Replacing polluting technologies	2020–2030	Ministry of the Economy and Innovation	691.34	608.87
P6-E	Promoting technological eco-innovation	2014–2027	Ministry of the Economy and Innovation	**	**
P7-E	Implementation of modern technologies	2014–2023	Ministry of the Economy and Innovation	45.31	**
P8-E	Promotion of non-technological eco-innovations	2014–2023	Ministry of the Economy and Innovation		
P9-E	Non-technological innovation development	2022–2027	Ministry of the Economy and Innovation		
P10-E	Promotion traditional industry transformation	2014–2023	Ministry of the Economy and Innovation		
P11-E	Promoting industrial digitization	2014–2028	Ministry of the Economy and Innovation		
P12-E	Improving energy efficiency in industrial enterprises	2022–2027	Ministry of the Economy and Innovation, Lithuanian Confederation of Industrialists	96.56	4,830.20
P14-E	Feasibility study for CO_2 capture and storage	2022–2026	Ministry of the Economy and Innovation	–	–
P15-E	Innovative green products and services	2022–2026	Ministry of the Economy and Innovation	100.92	481.49
P16-E	Buildings Data Bank	2023–2025	Public institution Construction Sector Development Agency, Ministry of Environment, State Territorial Planning and Construction Inspectorate, Agricultural data center	**	**
P17-E	Implementation of alternative fuel	2023–2026	Ministry of the Economy and Innovation	22.21	34.56
P18-E	Reducing the use of F-gases in businesses	2024–2025	Ministry of Environment	21.6	**
P19-E	Decarbonisation of industry	2025–2030	Ministry of the Economy and Innovation	356.2	1,189.23

P21-E	Life Cycle Modelling Methodology for Buildings	2024–2029	Public institution Construction Sector Development Agency, Ministry of Environment	**	**
P22-E	Promoting industrial change	2024–2026	Ministry of the Economy and Innovation	114.9	4,572.38
			Planned policy measures		
P17-P	Implementation of alternative fuel	2025–2030	Ministry of the Economy and Innovation	199.9	311.05
P19-P	Decarbonisation of industry	2027–2030	Ministry of the Economy and Innovation	116.3	361.69
P20-P	Long-term hedging contracts	2029–2035	Ministry of the Economy and Innovation	21.9	109.78

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

**** – The measure implements renewable energy solutions that do not directly contribute to fuel and energy savings but ensure the deployment of clean technologies.*

Descriptions of the policy measures:

P1-E. Reducing fluorinated gases. The measure includes: 1) The implementation of Regulation (EU) No 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014, which will result in a reduction of emissions from the use of fluorinated gases by 2030 by two thirds compared to 2014 levels (2015–2030); 2) The Kigali Amendment to the Montreal Protocol to ensure global climate protection from the use and production of hydrofluorocarbons (HFCs) – greenhouse gases with a high global warming potential (2019–2032).

P2-E. Improving energy efficiency. The measure includes: 1) Payment relief for services of general interest for industrial companies participating in the EU ETS, i.e. companies will be compensated for the implementation of energy efficiency improvement measures, equivalent to the measure EE5 (2021–2028); 2) The deployment of energy-efficient production technologies for energy-using manufacturing enterprises participating in the EU ETS in the large- and medium-size manufacturing sector, i.e. the digitalisation, upgrading, modernisation, optimisation, automation and optimisation of the manufacturing processes (2023–2030).

P3-E. Incentives for investment and innovation. There are currently corporation tax breaks for investment and innovation: to promote entrepreneurship – from 1 January 2018, a one-year corporation tax holiday for small start-ups, exempting them from corporation tax for the first year of operation; for investment, a relief focused on technological renewal and innovation, which allows taxable profits to be reduced by up to 100% of qualifying expenditure incurred for investment projects (2009–2028); for innovation, a relief focused on companies that develop new technologies in their business and then use them to generate income: 1) triple deduction of research and experimental activities (R&D) costs – allowing companies to deduct R&D costs three times from their income; 2) accelerated depreciation of assets used in R&D – allowing for the write-off of the acquisition cost of fixed assets used in R&D within two years; 3) Reduced tax rate for R&D commercialisation – an additional benefit for companies investing in R&D has been introduced from 2018, with a reduced corporate tax rate of 5% (from 1 January 2025 – 6%) for the commercialisation of inventions developed in R&D (profits from the use or disposal of assets developed in R&D).

P4-E. RES use in industry. Activities of the measure in enterprises not participating in the EU ETS: 1) Installation of RES-based energy production capacity, development and deployment of new technologies for more efficient use of RES in industrial enterprises, with the aim of using energy to meet the enterprises' own internal needs and allowing surplus energy to be fed to other industrial enterprises or to be fed into centralised energy grids (2014–2023); 2) Conduct of an energy audit of energy consumption in industrial enterprises (2014–2020); 3) on the basis of energy efficiency audit reports, investments will be made for the installation of RES-based energy production capacity, the development and deployment of new technologies for more efficient use of RES in industrial enterprises, with a view to using energy for the enterprises own internal needs, allowing surplus energy to be supplied to other industrial enterprises or to be fed into the centralised energy grid (2022–2027).

P5-E. Replacing polluting technologies. Actions for companies participating in the EU ETS: 1) Replacing polluting production technologies with less polluting ones, implementing best available techniques, etc. (2020–2021); 2) promotion of investments in the production and use of RES electricity in manufacturing industry, including investments in physical assets (equipment, technologies) that lead to GHG emission reductions and ensure continued environmental performance (2023–2030).

P6-E. Promoting technological eco-innovation. Actions for micro-enterprises, small and medium-sized enterprises (SMEs): 1) Encouraging micro-enterprises, SMEs to adopt technological eco-innovations (2014–2023); 2) Encouraging the development, demonstration and deployment of innovative environmentally friendly technologies in SMEs. Investments in eco-innovation, the development and production of sustainable/ "circular" products. Creating incentives for enterprises to demonstrate their digital and environmentally friendly technologies to SMEs potentially able to adopt them, enabling SMEs to learn about the benefits of these technologies (2021–2027); 3) Encouraging micro-enterprises and SMEs to introduce non-technological eco-innovations, i.e. to implement environmental management systems (EMS), to carry out technological/environmental audits of production, and to apply eco-design principles in the design of products. Support is foreseen for projects aimed at improving the environmental performance of products throughout their life cycle (selection and use of raw materials, production, packaging, transport, use), systematically incorporating environmental aspects at the earliest stage of product design. Also projects to promote product eco-labelling, i.e. the certification of products or services that are less harmful to the environment and human health than other products in the same product group (2014–2023); 4) Provide micro-enterprises and SMEs with the necessary information, advisory, methodological and other support on resource efficiency, conservation of natural resources, eco-innovation, etc., to stimulate SME investment in eco-innovation and other resource-efficient technologies (2014–2021).

P7-E. Implementation of modern technologies. The activities are targeted to SMEs: 1) Transformation of traditional industry through the introduction of technologies relevant for industrial innovation and growth of the economy as a whole – promotion/deployment of high impact technologies in the production processes of micro-small and medium-sized enterprises (2014–2021); 2) Encouraging micro-enterprises and SMEs to invest in the start-up and expansion of innovative manufacturing and/or innovative service businesses (2014–2021); 3) Encouraging micro-enterprises and SMEs to invest in the introduction of modern technologies to enable the adaptation of existing and the creation of new production capacities for the production of new and existing products (2014–2023).

P8-E. Promotion of non-technological eco-innovations. Encourage companies to invest in product/service design solutions to increase the attractiveness of the company's products or services, thereby increasing demand and productivity (2014–2023).

P9-E. Non-technological innovation development. Investment in brand, business process (excluding digital), design and organisational innovation is encouraged, the development of sustainable and more inclusive business models in international value chains (2022–2027).

P10-E. Promotion traditional industry transformation. Support for projects that develop and build infrastructure, acquire research and experimental development and innovation equipment and provide innovation advisory, innovation support or R&D services (2014–2023).

P11-E. Promoting industrial digitization. The measure includes: 1) Conducting a technological audit of industrial SMEs to assess the opportunities and prospects for digitisation of production processes of industrial SMEs and/or technological supervision of the implementation of the provisions of the technological audit (technological advisory services) and the deployment of equipment with integrated digitisation technologies in the production processes of industrial SMEs, based on the recommendations of the technological audit (2014–2023); 2) The deployment of process equipment with integrated digitisation technologies in industrial enterprises (giving priority to technologies in line with the smart specialisation strategy), including the technological audit of industrial enterprises and/or technological supervision of the implementation of the provisions of the technological audit (technological consultancy services) (2024–2027); 3) The stimulation of investment in the deployment of process equipment with integrated digitisation technologies in industrial enterprises in order to accelerate and improve the efficiency of the involvement of enterprises in international value chains (2024–2028).

P12-E. Improving energy efficiency in enterprises. The measure includes: 1) Incentives for energy efficiency audits in industrial enterprises. Based on the results of the audits, investments will be made to improve energy efficiency and reduce its intensity by enabling industrial enterprises to invest in the application of the latest and environmentally friendly equipment and technological solutions in their production processes, ensuring the continuity of these production processes, i.e. the renewal of the necessary technological equipment and infrastructure of existing technological processes (2022–2027); 2) Energy efficiency training in industrial enterprises to provide education and competence building in the field of energy efficiency (2022–2027).

P14-E. Feasibility study for CO_2 capture and storage. The study should assess the feasibility of developing and deploying CO_2 capture and storage technologies in Lithuania, considering the direct GHG emission reductions/entity/industry. The study should include the existing national legislative framework in this respect, the ongoing legislative processes at EU level (on hydrogen, the Renewable Energy Directive being renewed, the EU border carbon correction mechanism, etc.), to assess what changes to the legislative framework would be needed, and the necessary upgrading of the infrastructure, preparing it for the potential development. The recommendations of the analysis should be aligned with Lithuania's strategic energy and climate change objectives (2023–2025).

P15-E. Innovative green products and services. A financial instrument and a dedicated knowledge exchange platform will be set up to promote the development of environmentally friendly products and technologies. The measure aims to establish green hubs (Hubs for Circularity). These hubs would foster green and digital transformation. Possible activities of the hubs: a) investment in infrastructure; b) Investment in ecosystem facilitation and international networking; c) advisory services for green innovation; d) Investment in high technology readiness level (6-9) R&D activities (2022–2026).

P16-E. Buildings Data Bank. It is envisaged to create a data bank that will collect information on building characteristics, maintenance documentation, building condition, energy performance, energy and/or fuel consumption (costs), analyse this data for monitoring and promoting renovation, and provide information to the public on the current state of the buildings and the renovation process, to ensure a more efficient and data-driven decision-making process for renovation and maintenance of the buildings (2023–2025).

P17-E. Implementation of alternative fuel. In order to successfully transform industry and reduce dependence on fossil fuels in industrial processes, investments are foreseen to introduce alternative fuels such as, replacement of fossil fuel boilers with renewable energy heat pumps (air-to-water, ground-to-water, water-to-water, air-to-air), replacement of fossil fuels used in the production process with RES and/or electricity, etc., in industrial enterprises not participating in the EU ETS in the regions of Kaunas, Šiauliai and Telšiai. This activity will also enable the creation of sustainable jobs both in the municipalities most affected by the transformation and in the target regions, promoting sustainable development in all regions, enabling the transformation, decarbonisation and reduction of dependency on a single employer of enterprises operating in the regions (2023–2026).

P18-E. Reducing the use of F-gases in businesses. This measure aims to promote the replacement of old equipment or installations containing F-gas or mixtures of F-gas in public buildings (e.g. medical facilities, hospitals, retirement or children's homes, etc.), or the installation of new equipment or installations filled with F-gas replacing alternatives with minimal environmental and climate impact, for space cooling, air conditioning and air-conditioning purposes (2024–2025).

P19-E. Decarbonisation of industry. The measure aims to encourage companies to invest in energy efficiency improvements and to replace polluting technologies with less polluting ones. It supports investments in tangible assets (equipment, technologies) that increase energy efficiency and reduce the negative environmental impact of economic activities and ensure a continued environmental performance, i.e. investments in cleaner production innovations, digitalisation, modernisation, optimisation and automation of production processes, which increase the efficiency of the use of energy and/or raw material resources and contribute to the reduction of GHG emissions (2025–2030).

P21-E. Life Cycle Modelling Methodology for Buildings. The implementation of the measure would include the development and validation of a methodology for building life cycle modelling (2024–2029).

P22-E. Promoting industrial change. As part of the implementation of the European Green Deal in the industry, the provision of debt financing (subordinated loans, syndicated loans, direct loans) to improve the availability of finance for companies investing in transformation (change) by increasing circularity, investing in decarbonisation and energy efficiency, the deployment of environmentally friendly, low-impact, innovative and digital technologies, the production of high value-added products with a low CO_2 footprint in the fields of the defence and security industry (2024–2026).

P17-P. Implementation of alternative fuel. The activities of measure P17-E would continue (2025–2027).

P19-P. Decarbonisation of industry. The activities of measure P19-E would continue (2027–2030).

P20-P. Long-term hedging contracts. The measure aims to buy upfront (hedging) the result of emission reductions from companies not participating in the EU ETS. Long-term contracts with companies are planned, initiating and securing long-term emission reductions. Such contracts would provide companies with a fixed public support for each tonne of GHG emissions saved, based on the best available state-of-the-art technology at the time, with the price of CO_2 saved being determined

based on a forecast of the likely longer-term price. Technological audits are carried out, CO_2 emissions are assessed, and the company submits a report at certain intervals (monitoring). At the end of the period, the company is audited again to see how much it has saved/reduced GHG emissions and whether it has fulfilled its commitments, in the event of non-fulfilment the funds have to be repaid (2029–2035).

2.4.4. Agriculture

The National Climate Change Management Agenda (NCCMA) establishes the following climate change mitigation goals and tasks for the agricultural sector to be achieved by 2030:

- Implement innovative technologies, promote sustainable farming practices, and increase the added value across all branches of agriculture;
- Ensure efficient, cost-effective, and environmentally friendly use of fertilizers, aiming to reduce the use of nitrogen-based mineral fertilizers in agriculture by at least 15% compared to 2020 levels;
- Promote innovative, pollution-reducing livestock farming technologies and practices, including advanced cattle feeding methods, digitization of livestock farms, and productivity research;
- Enhance the sustainability of manure and slurry management to reduce methane, nitrous oxide, and ammonia emissions in livestock farming, ensuring that at least 70% of all manure and slurry generated is managed sustainably;
- Implement measures to reduce the direct and indirect release of nitrogen compounds into the environment due to agricultural activities;
- Double the area of organic farming compared to 2020 levels;
- Ensure that 50% of swine and cattle manure is used for biogas production;
- Encourage the use of scientifically proven, safe alternative methods for crop protection against pests and diseases, reduce the use of chemical pesticides, and expand the integrated pest management system;
- Shorten the food supply chain to bring it closer to consumers and promote urban agriculture to reduce transportation needs and distances;
- By no later than 2025, develop and implement a GHG accounting system at the farm level.

To achieve the sixth strategic objective of the **National Progress Plan (NPP)** – "Ensure good environmental quality, sustainable use of natural resources, protect biodiversity, mitigate Lithuania's impact on climate change, and increase resilience to its effects" sustainable activities based on bioeconomy principles are planned in the agriculture, forestry, and fisheries sectors (Progress Task 6.2). This includes expanding environmentally friendly farming and promoting the adoption of low-GHG emission technologies. A sustainable farming policy will be implemented, emphasizing the efficient use of mineral fertilizers and pesticides to reduce water pollution from nitrogen and phosphorus compounds and air pollution from ammonia. Efforts will be made to strengthen knowledge among economic operators about the consequences of climate change, air pollution, and biodiversity loss. Investment support will be linked to the adoption of sustainable production methods and technologies, and the sustainable use of soil, water, and other production resources. Additionally, afforestation, planting of perennial plants, wetland conservation and restoration will be encouraged

to increase the amount of GHG absorbed by agricultural land and forests. Adaptation measures to climate change will also be implemented in agriculture and forestry.

The 2022–2030 Program for the Development of Agriculture, Food, Rural Areas, and Fisheries identifies challenges faced by these sectors, including those related to climate change mitigation and resilience-building, as well as the causes of these issues.

The Lithuanian Agriculture and Rural Development Strategic Plan 2023–2027 (SP 2023–2027) sets a specific objective to contribute to climate change mitigation and adaptation. This includes reducing GHG emissions, increasing carbon dioxide sequestration, and promoting sustainable energy development. The implementation of this objective will be supported by standards for Good Agricultural and Environmental Condition (GAEC) and Management Requirements (MR) and various intervention measures. GAEC and MR standards and interventions will aim to reduce the use of mineral fertilizers and associated GHG emissions, lower GHG emissions from the livestock sector, increase the incorporation of plant residues into soil, reduce the mineralization of soil organic carbon, and enhance carbon sequestration in soil. These measures will ensure biomass growth and increase GHG removals in forests while improving the resilience of farms to climate challenges. Farmers will be incentivized with investment support to adopt technologies that reduce GHG and ammonia emissions, improve air quality, and convert farm manure and waste into energy, such as biogas plants for on-farm use. Investments in technological solutions that enhance animal welfare, which can also help reduce GHG emissions, will also be encouraged. The funding for SP 2023–2027 will be supplemented by resources from other sources, including the state budget, the 2021–2027 EU Funds Investment Program, the European Recovery and Resilience Facility, and the Modernization Fund.

The National Water Sector Plan for 2022–2027 and the Sustainable Soil Use Action Plan up to 2030 outline measures to reduce air, water, and soil pollution from agriculture, food production, and fisheries activities. These measures aim to ensure more sustainable use of these resources, while also contributing to climate change mitigation and adaptation efforts.

The policies and measures in the agriculture sector are presented in the table below.

Table 2-9. *Existing and planned policy measures in the agriculture sector by 2030*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
A1-E	Climate-friendly livestock farming (manure management)	2023–2027	Ministry of Agriculture	663.94	**
A2-E	Promoting the consumption of organic products	2021–2026	Ministry of Agriculture	**	**
A3-E	Development of precision fertilisation	2022–2023	Ministry of Agriculture	45.50	15.83
A4-E	Extensive maintenance of grasslands for livestock grazing	2022–2023	Ministry of Agriculture	*	**
A5-E	Promoting short supply chains	2024–2027	Ministry of Agriculture	268.76	833.60
A6-E	Development of protein crops	2023–2027	Ministry of Agriculture	190.71	**

A7-E	Development of no-till technologies, especially direct seeding	2023–2027	Ministry of Agriculture	392.67	1,101.11
A8-E	Climate-friendly livestock farming (enteric fermentation)	2021–2027	Ministry of Agriculture	1.58	**
A9-E	Promotion of organic farming	2023–2027	Ministry of Agriculture	118.21	**
A10-E	Promoting bioeconomy businesses	2023–2027	Ministry of Agriculture, Ministry of Environment, Ministry of the Economy and Innovation	**	**
A11-E	Management of gardens and orchards in a nature-friendly manner	2023–2027	Ministry of Agriculture	**	**
A12-E	Sustainable gardening and horticulture	2023–2027	Ministry of Agriculture	4.42	**
A13-E	Alternative fuel vehicles	2024–2025	Ministry of Agriculture, Ministry of Finance	22.16	***
A14-E	Reducing the use of fossil fuels in agriculture, forestry and fisheries	2021–2030	Ministry of Agriculture	246.15	849.44
A15-E	Revision of technological cards of agricultural work to reduce fuel consumption	2023–2030	Ministry of Agriculture	515.85	1,780.10
A16-E	R&D to identify and promote the most energy-efficient and climate-friendly farming practices	2024–2027	Ministry of Agriculture	59.66	**
A17-E	Information and consultancy on the application of sustainable farming methods	2023–2027	Ministry of Agriculture	0.99	**
A21-E	Balanced fertiliser system	2022–2025	Ministry of Agriculture	443.11	**
	Planned policy measures				
A1-P	Climate-friendly livestock farming (manure management)	2027–2030	Ministry of Agriculture	290.45	**
A2-P	Promoting the consumption of organic products	2025–2030	Ministry of Agriculture, Ministry of Environment	**	**
A3-P	Development of precision fertilisation	2026–2030	Ministry of Agriculture	26.14	12.5
A13-P	Alternative fuel vehicles	2026–2030	Ministry of Agriculture, Ministry of Environment	24.53	***
A18-P	Public education campaigns on healthy and environmentally friendly nutrition	2025–2027	Ministry of Health, National public health centre, Institute of Hygiene	16.97	**
A19-P	Sustainable use of public land	2026–2030	Ministry of Agriculture	20.48	**
A20-P	GHG accounting on farms	2027–2030	Ministry of Agriculture	9.66	**

** – The measure absorbs GHG in the LULUCUF sector.*

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

*** – *The measure implements renewable energy solutions that do not directly contribute to fuel and energy savings but ensure the deployment of clean technologies.*

Descriptions of the policy measures:

A1-E. Climate-friendly livestock farming (manure management). Investments will be directed towards efficient equipment and technologies to reduce GHG emissions from livestock farms, particularly those related to manure management. The aim is to apply acidification of slurry, incorporation of slurry into the soil and use of manure for biogas production. In addition to reducing GHG emissions, this will also lead to an increase in the efficient application of organic fertilisers to plants (according to actual plant needs and ensuring all soil quality parameters) (2023–2027).

A2-E. Promoting the consumption of organic products. The objective of the measure is to promote the consumption of products produced using organic and environmentally friendly methods and to reduce the consumption of environmentally unfriendly, unsustainably produced products. The measure provides for the reimbursement of the price difference between organic and conventional products to ensure that pre-school establishments consume a higher proportion of food produced using environmentally friendly methods. The promotion of green procurement (2021–2026) should contribute to this.

A3-E. Development of precision fertilisation. The measure will support the acquisition of precision technologies that will save fuel, reduce the use of crop protection products and fertilisers and improve soil health (2022–2023).

A4-E. Extensive maintenance of grasslands for livestock grazing. The measure is designed to encourage farmers to graze livestock extensively on grassland. The measure aims to have a positive impact on the different grassland habitats by maintaining and caring for grasslands and improving their condition. It will reduce soil loss due to erosion, increase soil organic carbon stocks, reduce the need for or avoid the use of mineral fertilisers, reduce the leaching of nutrients into water bodies and avoid GHG emissions from the conversion of grassland to arable land. The measure will also contribute to animal welfare objectives by promoting higher standards of cattle housing, which also contributes to lower GHG emissions (2023–2027).

A5-E. Promoting short supply chains. Short supply chains reduce the number of potential intermediaries between the producer and the final consumer and reduce transport costs. This has a significant impact on the viability of small and medium-sized farms and the greater integration of producers into the food supply chain. The measure contributes to the objectives of environmental protection and public health by encouraging the consumption of local produce, with particular emphasis on organic and quality system produce, and by reducing the carbon footprint by optimising transport costs. Short supply chain schemes aim to reduce the distances over which produce is transported to the final consumer. Also bringing the food supply chain closer to urban consumers by promoting urban agriculture/farming in urbanised areas (2024–2027).

A6-E. Development of protein crops. The cultivation of bell grasses requires large amounts of fertiliser to achieve fertility, which releases N_2O gas into the atmosphere. Leguminous grasses, which have formed symbiotic relationships with nitrogen-fixing bacteria, do not require additional nitrogen fertilisers, unlike bell grasses, when soil air permeability and mineral content are sufficient. Also, legumes have a high nutritional value, especially in terms of protein content, so that the cultivation of such a composition of grasses ensures a sustainable further use of protein material throughout the food chain (2023–2027).

A7-E. Development of no-till technologies, especially direct seeding. The measure aims to promote no-till agriculture, with a particular focus on promoting direct seeding. No-till agriculture, and in particular direct seeding, improves soil properties, soil fertility and carbon storage (2023–2027).

A8-E. Climate-friendly livestock farming (enteric fermentation). The measure aims to inform farmers about the impact of certain feed reformulations on GHG emissions while maintaining productivity: feed reformulation for pigs, limited reformulation of cattle feed to reduce methane emissions from cattle, informing cattle farmers about the potential of feed diversification to improve feed quality and thus cattle productivity (e.g. replacing conventional wheat and barley straw with maize, sorghum, etc.), reducing the carbohydrate content and replacing it with unsaturated fats in feed, adding nitrogen additives with slowly digestible nitrogen compounds, reducing the protein content of feed for dairy cows and avoiding over-feeding. In addition to correct and adequate rationing, which leads to lower GHG emissions, Lithuania promotes genetic testing and supports its implementation through breeding systems to assess the health of cattle, their potential to produce more and lower emissions.

A9-E. Promoting organic farming. The measure is designed to promote organic farming. The measure will address the challenges of providing the population with quality food, reducing negative environmental impacts, preserving biodiversity and maintaining the stability of ecosystems (2023–2027).

A10-E. Promoting bioeconomy businesses. The measure aims to encourage the production of innovative, high value-added products based on agricultural produce grown in Lithuania. Therefore, subsidies are provided for productive investments in innovative bio-economy businesses (2023–2027).

A11-E. Management of gardens and orchards in a nature-friendly manner. The measure is designed to encourage agricultural operators to manage their gardens and orchards in a nature-friendly way, with the aim of reducing the use of plant protection products, reducing the leaching of nutrients from the soil, and contributing to the conservation of biodiversity (2023–2027).

A12-E. Sustainable gardening and horticulture. The measure aims to encourage fruit, berry and vegetable growers to adopt more environmentally friendly production technologies, thereby contributing to preserving and improving soil quality and reducing pollution of surface and groundwater (2023–2027).

A13-E. Alternative fuel vehicles. The measure aims at replacing fossil-fuelled agricultural machinery and vehicles with second-generation biofuel and electric machinery (e.g. tractors, lorries, combine harvesters), with priority given to the adaptation of existing machinery to second-generation fuels. The measure is limited to those entities that would consume at least 50% of second-generation biofuels during the commitment period (2024–2025).

A14-E. Reducing the use of fossil fuels. The measure aims to promote the reduction of fossil fuel use in agriculture, forestry and fisheries through: 1) Regulatory action (e.g. limiting the amount of gasoil used in agricultural activities) (2021–2030); and 2) The design of new investment measures to promote the switch from fossil fuels to renewable energy sources and to increase energy efficiency (2022–2027). Also, through advice and the creation of a platform, to encourage the sharing of machinery between farmers, which would allow the exploitation of the overall potential of Lithuania's agricultural machinery resources. A potential land manager can farm with all the services he needs and can farm without capital, using existing capacities (2023–2027).

A15-E. Revision of the technology cards. The aim is to reduce the use of gas oils for agricultural use. The reduced fuel allocation would lead to savings of 20% of fuel consumption (2023–2030).

A16-E. Promoting research. The tool would investigate different farming practices by measuring their GHG emissions, production and carbon sequestration. The objective is to identify the most energy efficient and climate-friendly farming practices (2024–2027).

A17-E. Information and consultation. The objective of the measure is to publicise good practices for sustainable farming to reduce negative impacts on soil, water, air and climate. The aim is to make farmers aware of the implementation of organic schemes under the SP 2023–2027 direct support measures and through other policy instruments. Field days, information campaigns on soil-friendly technologies, practices promoting more efficient use of fertilisers and plant protection products and other climate-friendly agriculture activities are planned. The measure also aims to improve the knowledge of farmers and fish businesses on how to apply these advanced technologies and practices to reduce GHG emissions through advisory services. Encourage farmers to farm more sustainably, using the latest technologies and good practices (2023–2027).

A21-E. Balanced fertiliser system. Establishing a balanced fertiliser system with an efficient and reduced use of mineral fertilisers (per unit of yield or per hectare of crop): requiring the farm to report on the use of mineral fertilisers on the farm (by active ingredient); develop a methodology for the preparation of fertilisation plans to calculate the optimum amount of fertiliser per crop and require farms to prepare fertilisation plans for mineral and organic fertilisers. The measure also foresees the creation of a dedicated digital database for fertiliser and chemical plant protection products accounting, national accounting and control, and other digital solutions. The use of mineral N fertilisers on cropland is expected to decrease by 10% (2022–2025).

A1-P. Climate-friendly livestock farming (manure management). Expected extension of the scope of measure A1-E (2027–2030).

A2-P. Promoting the consumption of organic products. Expected extension of the scope of measure A2-E (2025–2030).

A3-P. Development of precision fertilisation. It aims to adapt the national legislative framework for the wider use of precision technologies (including drones), to transfer knowledge to end-users of the technologies, and to promote the acquisition of these technologies. Enabling the technologies will lead to fuel savings, reduced use of crop protection products and fertilisers and improved soil health (2026–2030).

A13-P. Developing precision fertilisation. The activities of the measure A13-E will continue (2026–2030).

A18-P. Environmentally friendly nutrition. The measure foresees various communication and education campaigns to inform the population about the negative impacts of unsustainable agricultural production (crop and livestock farming) on the environment and human health (2025–2027).

A19-P. Sustainable use of public land. The measure requires new contracts for the lease of public land to include requirements for organic or very low-pollution farming (e.g. limited use of mineral fertilisers and plant protection products, indicating that no-tilled farming is allowed, etc.). Ensure sustainability of activities on leased public land and limited negative impacts on the environment and climate (2026–2030).

A20-P. GHG accounting on farms. The measure is designed to enable the collection of data on farms (GHG emissions, soil conditions) and, using this data, the provision of advice to farmers, where the

advice relates to energy efficiency improvements, livestock production or crop technology, to identify and advise on how to reduce GHG emissions in production, on the farm itself. Enable the application of data-driven GHG reduction solutions on farms (2027–2030).

2.4.5. Land Use, Land-Use Change and Forestry

The National Climate Change Management Agenda (NCCMA) has set the following climate change mitigation goals and objectives for this sector by 2030:

- By 2030, harmoniously use agricultural land and forest land, protect and restore natural habitats that store organic carbon (forests, meadows, wetlands, swamps), ensure their good ecological condition, increase the use of wood in construction and production of long-lived products, without causing additional negative impacts on ecosystems. The goal is to increase the carbon absorption potential and use it efficiently, ensuring that the sector absorbs a significantly higher amount of GHG emissions than it generates, aiming for at least 6.5 million tons of CO_2 eq. from 2021 to 2030;
- Achieve a continuous reduction in the GHG emissions from cultivated land in the sector by implementing soil-friendly farming methods and improving soil condition;
- Increase the organic carbon stocks in forests and wood products, intensify annual organic carbon absorption through sustainable forestry, and extensively use local raw materials in wood products;
- Increase national forest coverage to at least 35% by 2024, giving priority to areas naturally covered by trees and shrubs, while adhering to ecological principles;
- Increase the area of perennial meadows by at least 8,000 hectares;
- Increase the areas where non-tillage technologies are used by 1.5 times by 2024 and three times by 2030.
- Ensure that at least 4% of agricultural land is used for biodiversity-rich landscape elements by 2024, and 10% by 2030;
- Restore at least 8,000 hectares of high-carbon ecosystems, ensuring their sustainable use, and halt the new exploitation of natural peatlands by 2024;
- Promote changes in consumption habits by increasing the use of products and energy from renewable wood resources, while reducing the use of more polluting non-renewable resources;
- Ensure and continually monitor the sustainability requirements to produce renewable wood products to avoid additional negative impacts on ecosystems;
- Promote the cultivation of industrially suitable plants (such as fiber plants) and their use in industrial sectors, increasing the organic carbon stocks in long-lasting products, ensuring that this does not have additional negative effects on ecosystems;
- Develop a high-added-value and circular bioeconomy, increasing its contribution to the national GDP.

The State Progress Strategy "Lithuania's Future Vision: Lithuania 2050" envisions Lithuania's strategic ambition to develop a climate-neutral, climate-resilient economy based on the restoration of natural ecosystems, balanced growth, and the principles of moderation. Lithuanian producers and consumers follow widely accepted and proven principles of responsible resource use and the circular economy. The state appropriately values and carefully uses all the benefits provided by nature (ecosystem services).

The National Sustainable Development Strategy outlines the opportunities for the sector to afforest lands on more fertile soils. It emphasizes the need for economic and administrative measures to restore exploited quarries, peat bogs, and abandoned old farm buildings. A national landscape management plan is being developed. The vision is that with natural reforestation and increasing forest cover and perennial plant areas in Lithuania, the expansion and integration of protected areas into international ecological networks will ensure landscape and biodiversity protection, slow soil erosion, and increase ecological stability. The mission states that increasing Lithuania's forest coverage will not only allow for more rational use of abandoned, low-yield, and agricultural land unsuitable for production but will also strengthen the country's nature's frame by adding forest elements and creating necessary connections, making it easier to integrate Lithuania's protected areas into European ecological networks.

The National Environmental Protection Strategy and the General Plan for the Territory of the Republic of Lithuania specify that the country's forest cover should reach 35% by 2030.

The National Landscape Management Plan aims to strengthen the nature's frame and ecological balance, improve land use processes, and address the issue of forest development and increasing forest coverage comprehensively (from the perspective of landscape and biodiversity, as well as ecological, social, and economic aspects), prioritizing the afforestation of ecologically depleted nature's frame areas.

The National Progress Plan (NPP) provides for the development of sustainable activities based on bioeconomy principles in the agriculture, forestry, and fisheries sectors. The main directions for environmental protection and climate change management are outlined in the 2022–2030 Environmental Protection and Climate Change Management Development Program of the Ministry of Environment of the Republic of Lithuania.

The Ministry of Environment's Environmental Protection and Climate Change Management Development Program has specific measures aimed at increasing forest coverage and developing a sustainable forestry sector. These include measures to form more productive forests, rational forest use, develop the forestry industry, and increase forest resilience and adaptability to climate change. The program allocates state budget funds to activities that address the problems and causes identified in the Ministry's program.

The Land Holdings Program sets the goal of improving landholding structures and reducing the area of abandoned land. Measures to achieve this include restoring the good agricultural condition of fertile abandoned land, including drainage works (evaluation criteria: restored agricultural land area in 2020 – 90 ha); preparing low-yield land unsuitable for agricultural use for afforestation, including forming the nature's frame and creating ecologically stable landscapes.

The Lithuanian Agricultural and Rural Development Strategic Plan 2023–2027 (SP 2023–2027) includes specific goals for contributing to climate change mitigation and adaptation, such as reducing GHG emissions and increasing carbon dioxide sequestration. It also focuses on developing sustainable energy. These goals will be implemented through good agricultural and environmental condition standards and various intervention measures. The implementation of these standards and measures will increase the incorporation of plant residues into soil, reduce the mineralization of organic carbon in soil, increase carbon sequestration, ensure biomass growth in forests, and increase GHG absorption, thereby improving farm resilience to climate challenges.

The SP 2023–2027 plans to commit 404,000 hectares (13.59%) of agricultural land to climate change adaptation measures and 839,000 hectares (28.21%) to commitments aimed at reducing GHG emissions or maintaining/increasing carbon stocks in soil and biomass.

A total area of approximately 1.67 million hectares (56%) of agricultural land will be supported by intervention measures related to climate change mitigation, adaptation, and increasing absorption potential.

Over 90% of the savings in the sector are planned to come from measures outlined in the SP 2023–2027, such as promoting crop rotation, encouraging cover crops, protecting drained peat soils used in agriculture, as well as extensive meadow maintenance and expanding no-till farming.

Parliament Resolution on Forest Policy outlines the Parliament's position on the long-term balanced direction of forest policy. The resolution is a non-normative act aimed at formally confirming the Parliament's view on a state matter. The challenges posed by climate change and biodiversity loss, as well as changing societal demands on the country's forests, prompted a fundamental review of Lithuania's forest policy directions. The Ministry of Environment initiated a National Forest Agreement in 2021, aimed at reaching consensus on the long-term, balanced direction of forest policy and addressing the concerns of different interest groups. The project for this national agreement was developed by about 40 different organizations and nearly 400 participants. Discussions took place in 150 events, and the final agreement was formed by nine thematic groups, six of which reached consensus. These have been incorporated into the Parliament's resolution, adopted with 72 votes in favour. In the summer of 2024, the government approved amendments to the Forest Law and related laws prepared by the Ministry of Environment, which will establish qualitative changes in the forestry sector, pending approval by the Seimas.

The existing and planned policy measures in LULUCUF sector are presented in the table below.

Table 2-10. *Existing and planned policy measures in LULUCF sector by 2030*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030	Total fuel and energy savings, GWh
		Existing policy measures			
L1-E	Peatland restoration (restoration of hydrological regime on agricultural land)	2024–2026	Ministry of Agriculture	-487	**
L2-E	Conservation and restoration of grasslands	2023–2027	Ministry of Agriculture	-2,772.33	386.8
L3-E	Management of natural wetlands	2023–2027	Ministry of Agriculture	-79.57	3.3
L4-E	Promotion of cover-crops	2023–2027	Ministry of Agriculture	-5,112.76	800
L5-E	Promotion of crop rotation	2023–2027	Ministry of Agriculture	-8,188.86	**
L6-E	Peatland restoration (grassland conversion)	2023–2027	Ministry of Agriculture	-967	**
L7-E	Promoting green cover	2023–2027	Ministry of Agriculture	-190	**
L8-E	Conservation and maintenance of landscape elements	2023–2027	Ministry of Agriculture	-146	**

L9-E	Afforestation	2024–2027	Ministry of Environment	-129	**
L10-E	The development of young stands	2024–2027	Ministry of Environment	-69.5	**
L11-E	Developing agroforestry and agrohorticulture	2023–2025	Ministry of Agriculture	**	**
L12-E	Promoting organic construction	2023–2025	Ministry of Environment	-1,051	**
L14-E	Protection of self-seeded trees	2024–2026	Ministry of Environment	-250.44	**
L15-E.	Improving the quality of forests	2023–2030	Ministry of Environment	127.4	**
L16-E	Determination of GHG targets	2019–2023	Ministry of Environment	**	**
L18-E	Afforestation	2023–2030	Ministry of Environment	-68	**
		Planned policy measures			
L1-P	Peatland restoration (restoration of hydrological regime on agricultural land)	2026–2030	Ministry of Agriculture	-162.45	**
L12-P	Promoting organic construction	2024–2030	Ministry of Environment	**	**
L13-P	Promotion of carbon storage farming (on agricultural land)	2022–2030	Ministry of Agriculture	**	**
L14-P	Protection of self-seeded trees	2026–2030	Ministry of Environment	-375.55	**
L17-P	Promotion of carbon storage farming (in forests)	2025–2030	Ministry of Environment	**	**
L20-P	Peatland restoration (restoration of hydrological regime in forests)	2024–2030	Ministry of Environment	-40	**

*** – The impact of the measure is not assessed as it does not directly reduce GHG emissions or fuel and energy savings, but it is essential for the successful implementation of the other envisaged measures.*

Descriptions of the policy measures:

L1-E. Peatland restoration (restoration of hydrological regime on agricultural land). Identify former drained peatland wetland areas in which it is appropriate to restore the hydrological regime, identifying their effectiveness in reducing emissions and, in the long term, absorbing GHG. Promote the restoration of drained swamps (peatland wetlands), restoring appropriate water levels and maintaining ecosystems through sustainable economic activities, paying special attention to peatland farming, the development of which would contribute to the development of a circular economy and the preservation of natural habitats (2024–2026).

L2-E. Conservation and restoration of grasslands. The measure is intended to encourage farmers to preserve grasslands and natural habitats. This measure intends for compensation for farmers who meet the specified requirements (for the management of natural grasslands of EC importance; for protection of wild birds outside the Natura 2000 area; support for Natura 2000 agricultural land) (2023–2027). The maintenance and care of permanent grasslands and the conversion of arable land to permanent grasslands are also encouraged (conversion of arable land to grasslands, their maintenance and care) (2024–2027).

L3-E. Management of natural wetlands. The measure is designed to encourage farmers to preserve wetlands. It provides for compensation to farmers who meet the requirements (2023–2027).

L4-E. Promotion of cover-crops. By implementing this measure, agricultural entities will be encouraged to grow cover-crops. Increasing cover-crop areas will not only improve the agrochemical composition and physical properties of arable land, but will also significantly contribute to reducing

environmental pollution and negative effects of climate change (activities on arable land – cover-crops) (2023–2027).

L5-E. Promoting of crop rotation. Under this measure, the annual application of at least 4 crop rotations will have a positive impact on the preservation of soil fertility. By switching from monoculture farming and applying crop rotation, the amount of organic carbon in the soil will be increased. By contributing to increasing carbon sequestration in the soil and reducing GHG emissions, this measure will have a direct impact on achieving the objectives related to climate change mitigation and adaptation. This measure intends for compensation for farmers who meet the specified requirements (activities on arable land – Crop rotation) (2023–2027).

L6-E. Peatland restoration (grassland conversion). The conversion of arable peatlands to grasslands will have a positive impact on reducing GHG emissions from peatlands, preserving soil fertility, reducing erosion, the formation of which in the soil is significantly influenced by intensive agriculture, and increasing the amount of organic matter. The measure aims to contribute to reducing the extent of ploughing of organic soils, promoting the restoration, preservation and regular maintenance of herbaceous plant cover of organic soils (2023–2027).

L7-E. Promoting green cover. The measure aims to reduce soil erosion and GHG emissions, increase the amount of organic matter in the soil and biomass by establishing grass strips, establishing and maintaining grassland on eroded land areas. By converting arable land into grasslands, it contributes to stopping soil erosion and reducing GHG emissions (measures: replacing eroded land with meadows; short-lived melliferous plant strips; perennial grass strips) (2023–2027).

L8-E. Protection of landscape elements. The measure aims to preserve and restore the traditional mosaic landscape. Areas with high mosaicity create conditions for various plant and animal species to live and reproduce, thus contributing to the preservation of biodiversity. Landscape elements will protect the soil from erosion, therefore the measure may have a direct positive impact on the implementation of the national objectives of preserving soil fertility, increasing the amount of organic matter, reducing erosion, and, depending on the type of landscape element, reducing GHG emissions and increasing removals (2023–2027).

L9-E. Afforestation. The measure aims to increase the country's forest cover by providing support to private landowners for afforestation, maintenance and protection (7 years after afforestation) (2024–2027).

L10-E. The development of young stands. The measure aims to strengthen the resilience of forest ecosystems to adverse environmental factors, to establish stands of target tree species, and to increase the productivity and absorption potential of stands (2024–2027).

L11-E. Developing agroforestry and agrohorticulture. Define the concept of agroforestry and agrohorticulture farming activities applicable in Lithuania, based on the best practices of other countries. Assess the potential for growing perennial crops (agroforestry and agrohorticulture) on agricultural land (according to the specificities of the land use) and the economic, social and environmental (including carbon storage) potential of the products or raw materials produced, as well as the development of mixed perennial crop-pasture systems (2023–2025).

L12-E. Promoting organic construction. The measure includes: 1) implementation of pilot building renovation (modernization) projects using standardized modular structures made of organic materials and the preparation of recommendations on their basis for the mass application of these solutions, which would allow for an average reduction in primary energy consumption by at least 30 percent (2023–2025); 2) support for the deployment of standardized modular structures made of organic

materials production capacities in Lithuania, necessary to implement the objectives set out in the Long-Term Renovation Strategy (2023–2025).

L14-E. Protection of self-seeded trees. The measure is intended to support the maintenance of self-seeded trees growing spontaneously on non-forest land (by compensating for part of the lost income from agricultural activities and the costs of inclusion in forest land accounting), with the aim of increasing the country's forest area by 2030 (2024–2026).

L15-E. Improving the quality of forests. The measure is designed to support reforestation with valuable tree species and the conversion of thinned and low-value stands to increase the area of more resilient and good quality forests by 2030 (2023–2030).

L16-E. Determination of GHG targets. Identify national GHG emission indicators and carbon stock change indicators to refine the ongoing GHG emission/absorption inventory and identify the most appropriate measures to reduce GHG emissions and increase removals in the LULUCUF sector (2019–2023).

L18-E. Afforestation. To increase the country's forest cover, around 300 ha of new forests are planned to be planted annually on public land (2023–2030).

L1-P. Peatland restoration (restoration of hydrological regime on agricultural land). Widening of the scope of L1-E measure (2026–2030).

L12-P. Promoting organic construction. Refurbishment/modernisation of multi-apartment buildings using standardised modular structures made of organic materials (2026–2030).

L13-P. Promotion of carbon storage farming (on agricultural land). The measure aims to promote the development of carbon storage farming practices and, where appropriate, regulatory measures to encourage the long-term storage of organic carbon in soils, dead organic matter and biomass, ensuring additionality and sustainability, and in line with ecological principles that are favourable to biodiversity and the natural capital (2022–2030).

L14-P. Protection of self-seeded trees. Continuation of L14-E measure activities (2026–2030).

L17-P. Promotion of carbon storage farming (in forests). The measure shall aim at increasing CO_2 storage by timely thinning and allowing trees to grow more freely and store CO_2. The activities are currently carried out in public forests, and it is planned to encourage private forest owners to carry out these activities as well, if possible. The level of compensation would depend on the type of deforestation or the application of a specific measure (2025–2030).

L20-P. Peatland restoration (restoration of hydrological regime in forests). Natura 2000 habitats 9080 are currently assessed as being in poor condition. This status is due to climate change and the re-introduction of old drainage systems that used to exist in these habitats. To avoid emissions from these peat forests, the hydrological regime is to be maintained or restored (2024–2030).

2.4.6. Waste

The National Climate Change Action Agenda (NCCMA) sets the following climate change mitigation goals and objectives for the waste sector to be achieved by 2030:

– Address the issue of food waste by reducing the amount of food waste per capita by 50% (2019 baseline: 41 kg per capita);

– Ensure that the share of municipal waste disposed of in landfills does not exceed 5% of the total weight of generated municipal waste;
– Recycle at least 70% of all packaging waste (by weight);
– Reuse and recycle at least 60% of municipal waste (by weight);
– By 2025, achieve a circularity rate (secondary raw material utilization index) at least equal to the EU average (2019 baseline: 11.9).

The Sustainable Development Strategy emphasizes that applying the "polluter pays" principle ineffectively in waste management will not create an effective waste management system. Without ensuring universal, high-quality, and accessible public municipal waste services, environmental pollution by waste could increase. The vision highlights that a regional waste management system will be established, and primary waste sorting will significantly reduce waste sent to landfills, increasing recycling. Currently, a regional waste management system has been established, and primary waste sorting is encouraged through both regulatory and financial measures.

The National Progress Plan (NPP) states that to rationally use natural resources, ensuring the quality of environmental services would contribute to improving the quality of life. A separate task in the program is dedicated specifically to the waste sector. In implementing this task, the focus is not only on municipal waste but also on preventing the generation of waste from economic activities so that the amount of production and other economic activity waste does not increase or at least increases at a much slower rate (at least twice as slow as production growth). The goal is to recycle as much waste as possible or reuse it, encourage the implementation of technologies and production methods that reduce resource use and/or prevent waste generation, and increase the use of secondary raw materials. The Industry Development Program emphasizes the goal of encouraging companies to implement the principles of regional industrial symbiosis, which allow saving raw materials and reducing waste.

The State Waste Prevention and Management Plan 2021–2027 (SWPMP), approved by the Government of the Republic of Lithuania on June 1, 2022 (Resolution No. 579), identifies the opportunities and threats related to waste management in Lithuania, emphasizing that the implementation of waste prevention measures at the national level will reduce the amount of waste generated and not reused, rationalize the use of natural resources and materials, and reduce the negative impact of waste on public health and the environment. One of the key indicators of the SWPMP is to reduce GHG emissions from the waste sector. The goal is to increase the reuse and recycling of municipal waste by 2030 so that at least 60% of generated municipal waste (by weight) is reused and recycled. The amount of waste sent to landfills, in line with the task set in the National Progress Plan, should be significantly reduced by 2030, with only up to 5% of all generated municipal waste (by weight) disposed of in landfills.

In implementing these goals, the SWPMP specifies that municipal waste management should be organized in a way that encourages waste to be properly prepared for reuse and recycling. By 2023, the amount of separately collected biological waste and sorted municipal waste should account for at least 60% of the total municipal waste generated. This target will increase to 65% in 2024, 70% in 2025, 75% in 2026, and 80% in 2027. By 2024, it is planned to ensure that households have access to biological waste collection tools or that waste is composted on-site.

The plan also aims to encourage the development of infrastructure for recycling textiles, plastics, green waste, and food waste by 2030, with the goal of recycling an additional 88.5 thousand tons of waste into secondary raw materials. Additionally, it encourages the implementation and expansion of technologies that ensure the possibility of using more secondary raw materials in production, thus

promoting recycling and reusing waste as raw materials, reducing resource consumption, waste quantities, and GHG emissions.

An equally important aspect of GHG reduction in the waste sector is waste prevention. The plan sets the goal that the amount of municipal waste generated per capita should not exceed the EU average. The SWPMP also plans to promote the reuse of items and place greater emphasis on food waste prevention.

Lithuania's Guidelines for Transition to a Circular Economy by 2035, which were approved by the Government on June 21, 2023, aim to establish a framework for implementing circular economy policies. The goal is to create conditions for more sustainable resource use across the entire lifecycle of products and materials, ensuring cooperation among stakeholders. The aim is not only to create an environmentally friendly economic system but also to take advantage of the country's growth and competitiveness opportunities by applying new technologies, business models, and forms of collaboration. The guidelines aim to address the problems caused by the traditional linear economy, which results in the depletion of natural resources, waste, and environmental degradation, all of which significantly affect climate change, biodiversity loss, and the worsening of environmental quality, posing an increasing threat to the well-being of the population.

The policies and measures in the waste sector are presented in the table below.

Table 2-11. *Existing and planned policy measures in the waste sector by 2030*

No	Measures	Implementation period	Entities responsible for implementing the policy	Total GHG reduction effect, thous. t CO_2 eq. 2021–2030
		Existing policy measures		
K1-E	Waste management	2021–2024	Ministry of Environment, Environmental Project Management Agency	74.5
K2-E	Development of waste collection facilities	2014–2030	Ministry of Environment, Environmental Project Management Agency	118.5
K3-E	Wastewater management	2014–2030	Ministry of Environment, Environmental Project Management Agency, Municipalities	315.0
K4-E	Waste sorting	2024–2030	Ministry of Environment	23.2
K5-E	Food waste prevention	2024–2027	Ministry of Environment, Ministry of Agriculture	15.5
K6-E	Circularity in public procurement	2024–2025	Ministry of Environment	29.3
		Planned policy measures		
K7-P	Research and experimental development	2024–2027	Ministry of Environment, Ministry of Education, Science and Sport, Research Counsil of Lithuania	–
K8-P	Home composting	2025	Ministry of Environment	30.35

Descriptions of the policy measures:

K1-E. Waste management. The measure includes: 1) subsidies and grants for the acquisition and management of bio-waste collection facilities through the creation and/or adaptation of existing infrastructure for the treatment of food/kitchen waste (2021–2023); 2) the development of infrastructure for the treatment of bio-waste, through the support of projects for the production of biomethane gas and/or the setting up of biogas purification plants (2020–2030); and) the alignment of the tax for the treatment of environmental pollutants, including an increase in landfill tax (2021–2023).

K2-E. Development of waste collection facilities. The measure includes: 1) raising awareness of the residents about the opportunities, benefits and disposal sites of waste sorting through various information dissemination channels and tools. Information includes both theoretical information on the benefits and environmental impacts of recycling and practical information on where and how they can sort their waste (2024–2030); 2) development of infrastructure for separate collection of municipal waste: upgrading, refurbishing or new construction of bio-waste collection containers and/or composting facilities for individual households; installation/refurbishment of container sites and purchase of containers for container sites; installation/refurbishment of bulky waste collection sites and/or adapting them for preparing waste for re-use (2014–2024); 3) Subsidies and grants for the purchase of individual containers for secondary raw materials (glass/paper/cardboard/plastics/metal) and textiles, and for the purchase of bio-waste collection facilities (2021–2026).

K3-E. Wastewater management. The measure includes: 1) projects involving the reconstruction and new construction of wastewater treatment plants (2018–2023); 2) projects involving the reconstruction and/or new construction of drinking water supply and/or wastewater collection networks and the reconstruction and/or new construction of water improvement and/or wastewater treatment plants (2014–2023); 3) the construction of sewage sludge treatment plants to treat sewage sludge generated by wastewater treatment plants in the Telšiai and Utena regions (2015–2023); 4) the development of wastewater management systems, including the installation of separate and group wastewater management systems, which would ensure environmental protection equivalent to that of a centralised wastewater collection system; the reconstruction of urban wastewater treatment plants that discharge untreated wastewater into the natural environment and/or have a pollution load above or close to the treatment plant's design capacity, and for which the construction has not been financed by the EU (2024–2030).

K4-E. Waste sorting. The measure includes: 1) the development of separate collection of municipal waste, with priority given to the collection of household food (kitchen), green, textile, hazardous waste, the installation of bulky waste collection sites, and infrastructure for the collection of reusable waste (2024–2030); 2) the modernisation and development of infrastructure for the preparation of waste for recycling and recycling; installation of new facilities for textiles, furniture, plastics, combined packaging, bio-waste, electrical and electronic waste and other waste (2024–2030); 3) publicity campaigns by municipalities to promote the separate collection of waste (especially food, textiles, construction, furniture, packaging, tyres, hazardous waste) (2024–2027).

K5-E. Food waste prevention. The objective is to finance national publicity campaigns on reducing and preventing food waste and reusing things (2024–2027).

K6-E. Circularity in public procurement. Supplement the description of the procedure for applying environmental criteria in green procurement with circularity criteria/principles (2024–2025).

K7-P. Research and experimental development. The measure will fund research and development on the circular economy, with key investments in reuse, the substitution of fossil raw materials by bio-based and secondary raw materials, the production of durable products, the development of new training programmes, and the changing of consumer habits (2024–2027).

K8-P. Home composting. The measure plans to amend the legislation to provide for a lower waste management charge for residents who compost their household bio-waste (2025).

3. METHODS FOR EVALUATION PAMS EFFECTS

Since 2019 preparation of PaMs and projections reports is closely linking with the preparation of NECP reports pursuant to Art. 17 of Regulation (EU) 2018/1999. The update of the NECP is an important part of the implementation of the international climate change objectives set out in the Paris Agreement and the EU climate change and energy policy mitigation (GHG reduction) targets and objectives until 2030. In 2022 evaluation of NECP measures was carried out. To achieve high quality result of NECP update, the Ministry of Environment has set up 5 sectoral decarbonisation working groups, where representatives of business, science and NGOs gave suggestions on GHG reduction measures. The Ministry of Environment, sectorial ministries, the EPA experts and consultants of the Ministry of Environment reviewed the proposed measures based on the sectorial objectives, development trends, economic and social aspects. The EPA experts re-evaluated the final list of PaMs. This list is in updated NECP and used for the current submission of the PaMs/projections report.

In this submission we present renewed information on the policies and measures and their effects. The methods of the estimation of the impact differ in separate sectors. The expert groups of different areas trough discussions determined the ex-ante effect of planned measures. These experts presented the Ministry of Environment their estimated sectoral parameters and predictions, and the EPA estimated the GHG mitigation effects according to the IPCC 2006 guidelines. Additionally, planned measures were discussed with various stakeholder groups. All the additional measures were incorporated in the GHG projection scenario “with additional measures”.

Energy sector

Lithuanian energy agency evaluated the development of energy sector and provided data on fuel balances for WEM and WAM scenarios as well as impacts of measures in energy units (amount of fuel or energy saved or replacement with renewable resources) to the EPA. The impact of individual measures on GHG emissions were calculated using emission factors for each type of fuel and energy.

Transport sector

PaMs in transport sector were evaluated by specialists in the EPA. Every PaM had an indicator or its extent, or both, which was used for evaluation. All the impact assessments ended up by calculating fuel savings or changes to biofuels, electricity or other alternative energy sources, except for measures that have relatively small effect, which were evaluated by expert judgement. The mentioned fuel savings were multiplied by GHG emission factors, to be in line with 2006 IPCC guidelines. To evaluate fuel savings, a comprehensive list of parameters and factors (for example, fuel consumption per kilometre or per vehicle) was used together with additional literature, studies, assumptions or information provided by responsible institutions.

Several PaMs do not directly reduce GHG emissions but are important for implementing other PaMs in the transport sector.

Agriculture sector

The mitigation effect of planned measures of A3-P and A13-P were estimated according to assumptions provided by the Ministry of Agriculture, scientific literature and GHG estimation methods provided in the 2006 IPCC methodology. Estimated mitigation effect of planned measure A1-P, A2-P, A18-P, A19-P, A20-P was assessed based on consultations with scientist and scientific research reports. Therefore, WAM scenario was estimated as the difference between the WEM

scenario and estimated planned measures GHG mitigation effects. The mitigation effect of planned measures A3-P and A13-P were included under the energy sector.

IPPU sector

In general, two main factors have a major impact on the evolution of emissions in IPPU sector: changes in industrial production and technological progress. In the IPPU sector, most emissions other than F-gases are covered by the EU Emissions Trading Scheme (ETS), which is the main instrument for reducing emissions from process emissions. In addition, the focus is on increasing the financing of investment in new technologies in order to stimulate the uptake of low-carbon technologies in industrial processes.

The WEM projection for F-gases includes the impacts of the EU regulation: Regulation of Fluorinated Greenhouse Gases (F-gas Regulation) and Kigali Amendment to the Montreal Protocol by limiting the use of hydrofluorocarbons (HFCs). The WAM F-gases projection is based on an additional measure that will slightly accelerate emission reductions.

Waste sector

The mitigation impacts of the measures were calculated using the IPCC waste model considering the effect of each measure on the amount/composition of waste disposed of in landfills or planned recovery of the methane. In Waste sector planned measures has been estimated individually. The impact of the existing measures was assessed by the IPCC waste model, taking into consideration the impact of each measure on the amount/composition of waste disposed of in landfills and planned recovery of the methane.

LULUCF sector

The evaluation of the effect of existing and planned measures was performed using 2006 IPCC Good Practice Guidance for National Greenhouse Gas Inventories, Vol. 4 Agriculture, Forestry and Other Land Use, in line with annual National Greenhouse Gas Inventory. The effect of the existing and planned policies and measures in the LULUCF sector is evaluated every year, taking into account assumed area changes of different land use. Therefore, it can be broadly concluded that all existing and planned measures are based on area changes. The effect of PaMs was estimated either on biomass (woody or herbaceous vegetation) or soil (mineral or organic) carbon stock changes. The effect of the implementation of PaMs was evaluated, taking into account annual land-use area changes and primary biomass or soil stock change factors:

- nationally developed growing stock volume changes for newly afforested areas (used for estimation of carbon stock changes in biomass) in L9-E, L10-E, L14-E, L18-E and L14-P measures;
- default values on biomass carbon stock of grassland and cropland, as provided in Table 6.4 of 2006 IPCC Guidelines;
- national carbon stock values for forest litter and mineral soils in forest land, cropland and grassland;
- default factors on carbon stock change used for cropland mineral soil organic carbon stock changes estimation due to management practices applied, as provided in Table 5.5 of 2006 IPCC Guidelines;
- default emission factor for drained organic soils in cropland and grassland, as provided in Tables 5.6 and 6.3 of 2006 IPCC Guidelines.

Several PaMs do not have direct impact on GHG reduction, therefore the mitigation impacts are not estimated.

4. GHG Projections

4.1. Energy

4.1.1. Overview of the energy sector

Many factors had influenced changes of energy consumption in Lithuania: deep economic slump in 1991–1994, fast economic growth over the period 2000–2008, dramatic reduction of economic activities in all branches of the national economy, decommissioning of Ignalina Nuclear Power Plant (NPP) in 2009, a significant increase of energy prices, an increase of energy efficiency and other reasons.

Total final energy consumption (excluding non-energy use) in 1990 amounted to 405.26 PJ (9.68 Mtoe). In 1991–1994 final energy consumption decreased approximately by 2 times (Figure 4-1). The final energy consumption was increasing during the period 2000–2007 by 4.8% per annum, and in 2007 it was 218.3 PJ (5.2 Mtoe) (State data agency, 2004–2022). During this period the final energy consumption was increasing in all sectors of the national economy.

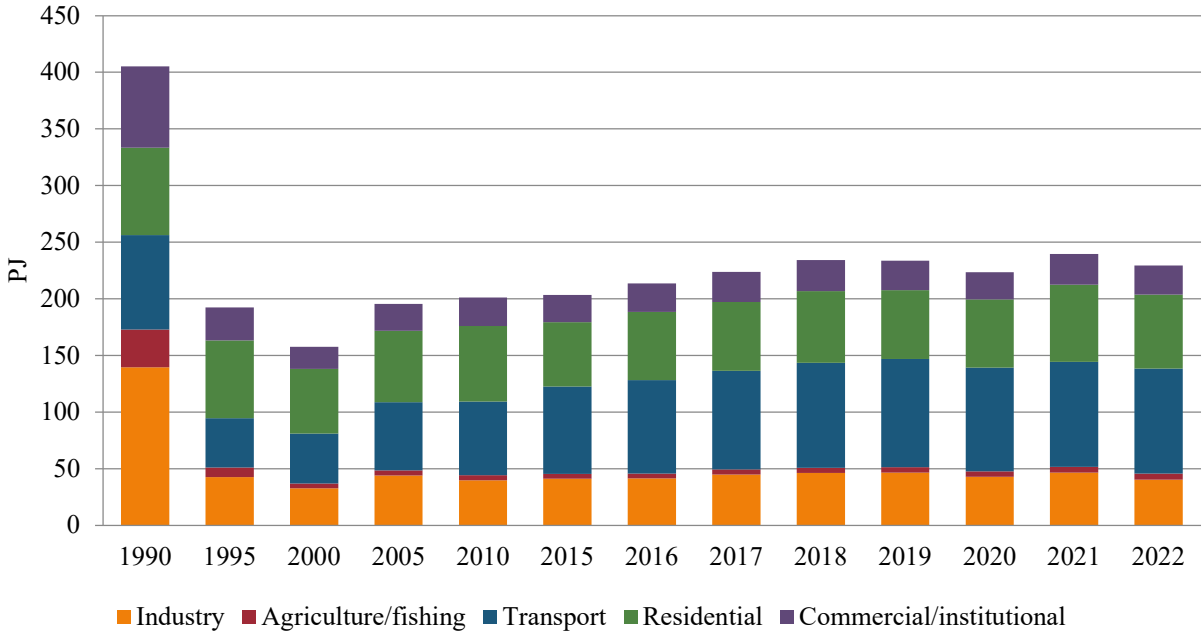

Figure 4-1. Final energy consumption in Lithuania[6]

In 2009, total final energy consumption was smaller by 9.5% than in the previous year, and the most severe impact of the economic recession was in the construction sector where energy consumption decreased by 34.9%. Energy consumption decreased in the transport sector by 18.5%. As a result of recovering Lithuanian economy, final energy consumption increased by 3.5% in 2010. During 2011–2015 the final energy consumption remained rather stable, but it was increasing by 4.8% per annum during 2015–2018. This increase was mainly influenced by energy demand increase in transport sector. In 2018, the final energy consumption amounted to 234.2 PJ (5.6 Mtoe). In 2020, the final energy consumption decreased by 4.4% due to COVID-19 pandemic and warm weather in heating season months. It amounted to 223.5 PJ (5.34 Mtoe) in 2020. In 2021, after COVID-19 lockdown, final energy demand increased by 7.2% and amounted 239.7 PJ (5.73 Mtoe). In 2022, final energy

[6] National Greenhouse Gas Inventory Document, 2024 of the Republic of Lithuania (NID, 2024).

demand decreased by 4.3% and amounted 229.3 PJ (5.48 Mtoe). This decrease was impacted by the war in Ukraine and the increase of energy prices.

In 2022, CO_2 eq. emissions contributed about 95.4% of total energy sector GHG emissions. Total GHG emissions from the energy sector have decreased by almost 3 times from 33,145.2 kt CO_2 eq. in 1990 to 11,742.5 kt CO_2 eq. in 2022 (Figure 4-2).

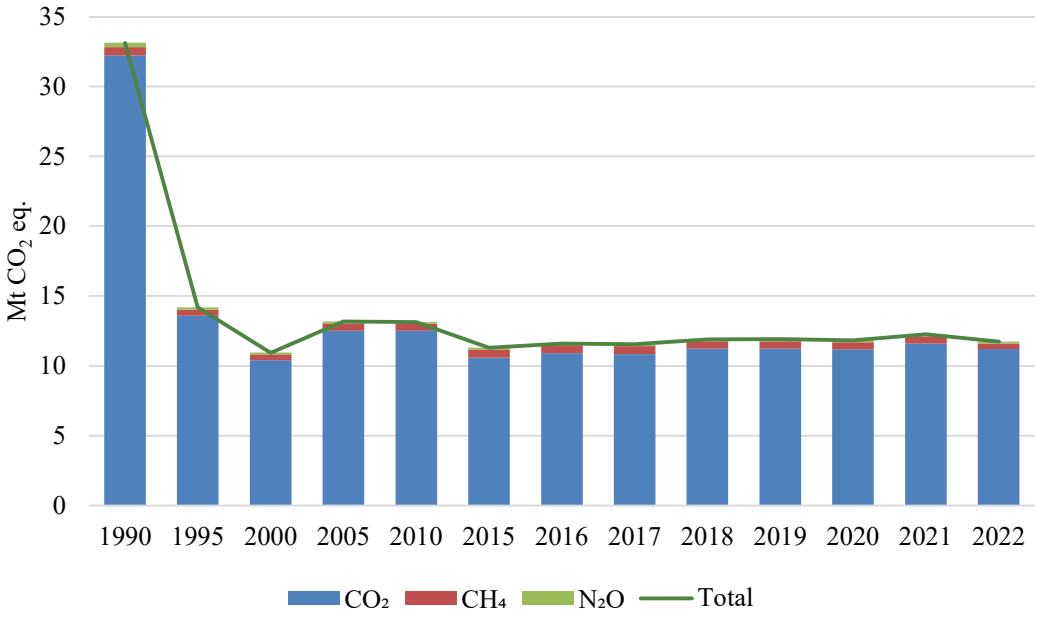

Figure 4-2. Total GHG emissions in the energy sector

A significant decrease in emissions was mainly due to the economic slump in 1991–1994. During the fast economic growth over the period 2000–2007, GHG emissions in the energy sector increased by about 3% per annum. The global economic recession impacted GHG reduction by 8.8% in 2009. The closure of Ignalina NPP and the increase in GDP raised GHG emissions by 8.1% in 2010. In 2011, total GHG emissions in the energy sector decreased by 6.5% due to a 22.4% decrease of GHG emissions in the public electricity and heat production sector. There was a noticeable increase in electricity import from neighboring countries, the use of renewable energy sources, and natural gas. The level of total GHG emissions in the Energy sector in 2012 remained almost the same as in 2011. In 2013, total GHG emissions decreased by 5% and in 2014 by 3.2% due to the high share of electricity imports and use of renewable energy sources. In 2015, total GHG emissions remained almost the same as in 2014. In 2016 and in 2018, total GHG emissions in the Energy sector increased by 2.8% and by 3.1% respectively due to the increasing GHG emissions in the transport sector. In 2019 and 2020, total GHG emissions in the Energy sector remained almost at the 2018 level. In 2021, total GHG emissions increased by 3.6% due to increased economic activities after recovery from COVID-19 and climate conditions. In 2022, total GHG emissions in the energy sector decreased by 4.2%. The decrease in GHG emissions was influenced by the reduction in energy demand due to the war in Ukraine, increase of energy prices and climatic conditions.

4.1.2. Methodologies and key assumptions

Energy sector constitutes of six main subsectors (*Energy Industries, Manufacturing Industries and Construction, Transport, Other sectors, Other* and *Fugitive emissions from fuels*) for which GHG emissions are projected. Projections of GHG emissions from transport sector are reported separately in the Chapter 4.2.

4.1.2.1. Scenario "with existing measures" (WEM)

The projections were carried out by firstly determining the consumption of fuel in every subsector up to the year 2055. The obtained fuel consumption was then multiplied by emission factors of every fuel to estimate projected GHG emissions. Thus, GHG projections fully correspond to the methodology used for preparation of National GHG inventory.

The fuel consumption trends up to the year 2055 were obtained carrying out systematic modelling of consumed fuel and energy types in economy sectors of Lithuania. The model relies on statistical data, reflecting existing situation of energy consumption, and special assumptions which affect projections of energy consumption change (such as measures for the increase of direct energy consumption efficiency, electricity and heat production efficiency, measures for the change of fuel consumed, promotion of the change of consumer behaviour, technology trends observed in the market, etc.). The model is controlled by the Lithuanian Energy Agency.

Fuel demand for house heating will decline due to the increased energy efficiency and renovation of residential and public buildings.

The military aviation activity (category 1.A.5 Other) is defined as activities using fuel purchased by or supplied to the military authorities of the country. The GHG emissions in this sector are mainly related to the consumption of jet kerosene as the main fuel. However, it is very difficult to anticipate fuel consumed by NATO airships, so the forecast shows no change in fuel consumption in the future.

Forecast of activity data of oil production up to 2040, which was used in subsectors 1.B.2.a Oil and 1.B.2.c Venting and flaring, was provided by Lithuanian Geological Survey. It was assumed that oil production shall decrease after 2040 and will be stopped in 2050. For projections in category 1.B.2.b.iv Natural gas transmission and storage, forecast of natural gas leakages was provided by natural gas transmission enterprise. For category 1.B.2.b.v Natural gas distribution, natural gas leakages were expected not to change since 2022.

The scenario "with existing measures" includes the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2023–2040.

Main measures and assumptions used for projecting GHG emissions in the energy sector:

- National Energy Independence Strategy determines the target to achieve that the part of RES in the final energy consumption balance would be no less than 55% by 2030 and 95% by 2050.
- National Energy Independence Strategy determines the target to reduce energy consumption by 1.23 times in 2030 compared to 2022 level, and by 1.5 times in 2050, compared to 2022 level.
- When evaluating the new EU ETS 2 (measure T28-E) it was assumed that the price of an emission allowance in this scheme will increase from €25/t CO_2 in 2027 to €50/t CO_2 in 2030. This price has been converted into a direct increase in the price of fuel for each fuel type and the effect of the measure has been calculated using price and fuel elasticities.
- AEI17-E (activity No. 3). Additional biofuel CHP unit entered operation in Vilnius in 2023. The CHP unit in Vilnius generates electricity for the Lithuanian power grid and heat for the district

heating system of Vilnius. The CHP plant consists of two units, one fuelled by non-recyclable municipal waste and the other by biomass. The biomass unit has a capacity of 73 MW of electrical power and 175 MW of thermal power. It's planned that the project promotes energy efficiency with expected energy savings of around 40%. Promotion of high efficiency cogeneration in Vilnius, and the promotion of use of biofuel for heat energy generation – these assumptions were incorporated during the calculation of final fuel used in Lithuania.

- AEI17-E. Promoting the use of RES in district heating. According to the approved measure, 158.25 MW of power of biomass heat plants will be built until 2030.

- EE2. Renovation/modernization of multi-apartment buildings. Renewed in 2014, this measure is planned up to 2026 in case of WEM scenario. Further application of the measure is foreseen in WAM scenario. The objective of this measure is to renovate 1,086 apartment buildings each year. Planned heat savings due to the complex renovation will be up to 70 kWh/m2.

- EE4-E. Agreements with energy suppliers on consumer education and advice. Since 2017, energy suppliers must make agreements with Ministry of Energy concerning education and consulting of end users for issues of increasing efficiency. It is planned that this measure will save about 280 GWh of energy because of behavioural changes in end users each year up to 2030.

- EE5-E. PSO relief for industrial companies. This measure is approved in 2019. According to it, large industry companies are promoted to install measures increasing energy efficiency, thus reducing consumption of energy. It is planned that about 77 GWh of energy will be saved each year until 2028 in manufacturing industries.

- EE6-E. Energy saving agreements with state and municipally owned companies. Since 2017, energy companies must make agreements on energy saving with the Ministry of Energy. According to these agreements, they must install measures to increase energy efficiency for end users. It is planned that this measure will save about 68 GWh of energy each year until 2030.

- AEI9-E. Reduce CO_2 emissions from the LNG terminal. The measure aims to reduce GHG emissions in the terminal by up to 30% through the installation of an electricity interconnection from the LNG terminal to land. The effect of the measure is expected from 2028.

- AEI10-E. Investment support for the installation of biomethane production and biogas purification plants. The measure aims to finance biomethane production facilities, including biogas cleaning facilities. The aim is to create a production capacity of 1,400 GWh of biomethane gas in 2030.

- AEI15-E. Developing green hydrogen production. New green hydrogen (hydrogen produced from renewable energy sources) production capacity (in total 91 MW) will be developed in various sectors to replace conventional fossil fuels, help balance the power system, produce hydrogen-derived products and reduce GHG emissions.

4.1.2.2. Scenario "with additional measures" (WAM)

The main additional (WAM scenario) measures to increase energy efficiency, which will reduce energy consumption until 2055, are continued renovation of multi-apartment, one- and two-apartment and non-residential buildings and continued replacement of boilers with more efficient technologies.

An additional measure, which will contribute most to the promotion of RES consumption in electricity and heat production until 2055, is investment support for the installation of biomethane production and purification facilities.

However, in WAM scenario, due to additional biomethane demand in transport, where priority for biomethane consumption is given, less biomethane is left for stationary combustion and natural gas will have to be consumed instead of biomethane there. For this reason, GHG emissions from 1.A.1.b (Petroleum refining) and 1.A.1.c. (Manufacture of solid fuels and other energy industries) in WAM scenario are higher than in WEM scenario, and this can be seen in Annex XXV Table 1a when comparing the scenarios for years 2025 and 2026. For later years, hydrogen additionally injected into natural gas grid compensates the increase of GHG emissions in WAM scenario, as well as additional biomethane plant facilities are foreseen from 2028.

Heat sector will also change in WAM scenario – share of RES in district heating systems should amount to no less than 90% by 2030.

4.1.3. Projections of GHG Emissions

4.1.3.1. Scenario "with existing measures" (WEM)

This chapter will overview the projected GHG emissions results in energy sector according to scenario with existing measures.

As was mentioned before, the GHG emissions in energy sector was determined by firstly estimating the consumption of fuel in energy consumption sectors.

It is estimated that the total primary energy consumption will gradually decrease. The decrease in primary energy consumption is mainly associated with improvement of energy efficiency and decreasing population in Lithuania. The regular population was 2.831 million in 2022 in Lithuania, and it was assumed that the population will be 2.742 million in 2030 and 2.25 million in 2055.

The share of each energy subsector in total projected GHG emissions is presented in Table 4-1. It is estimated that public electricity and heat production, petroleum refining, and residential sectors will remain the main sources of GHG emissions in the energy sector. Emissions in manufacturing industries shall decrease more than 2 times and will not belong to the main sources.

Table 4-1. *Projected GHG emissions from energy subsectors, kt CO_2 eq.*

Sector	BY 2022	2025	2030	2035	2040	2045	2050	2055
Public Electricity and Heat Production	1,234.8	1,300.7	1,223.2	1,307.7	1,307.7	1,307.7	1,307.7	1,307.7
Petroleum Refining	1,242.8	1,291.1	1,186.2	1,186.4	1,186.4	1,186.4	1,186.4	1,186.4
Manufacture of Solid Fuels and Other Energy Industries	52.0	51.8	27.2	28.2	28.2	28.2	28.2	28.2
Manufacturing industries and construction	1,206.4	1,057.8	670.1	625.7	606.8	593.5	578.5	564.5
Commercial/Institutional	297.3	238.4	165.7	168.1	166.7	166.2	165.9	165.8
Residential	971.9	905.3	798.4	847.4	833.8	832.1	830.2	828.2
Agriculture/Forestry/Fishing	278.2	261.2	225.0	225.9	226.8	227.7	228.6	229.5
Military aviation	29.9	27.4	27.4	27.4	27.4	27.4	27.4	27.4
Fugitive emissions from fuels	417.9	554.6	538.4	538.0	537.9	537.8	537.7	537.7

It was estimated that increased energy consumption efficiency and use of biomass and waste together with the change of polluting technologies will decrease the use of fossil fuel in manufacturing industries and construction sub-sector by 44% in 2030 which will lead to decrease in GHG emissions

in this sector. It was also estimated that increased use of heat pumps and implemented CO_2 taxes will decrease the use of fossil fuel in commercial/institutional sector by 32% in 2030. Increased energy consumption efficiency together with the latter aspects will decrease the use of fossil fuel in residential sector by 14% in 2030 which will lead to decrease in GHG emissions in this sector. GHG emissions in other sectors shall remain rather stable.

The overall situation in energy sector starting from 1990 and the projected emissions up to year 2055 are presented in Figure 4-3 and Figure 4-4.

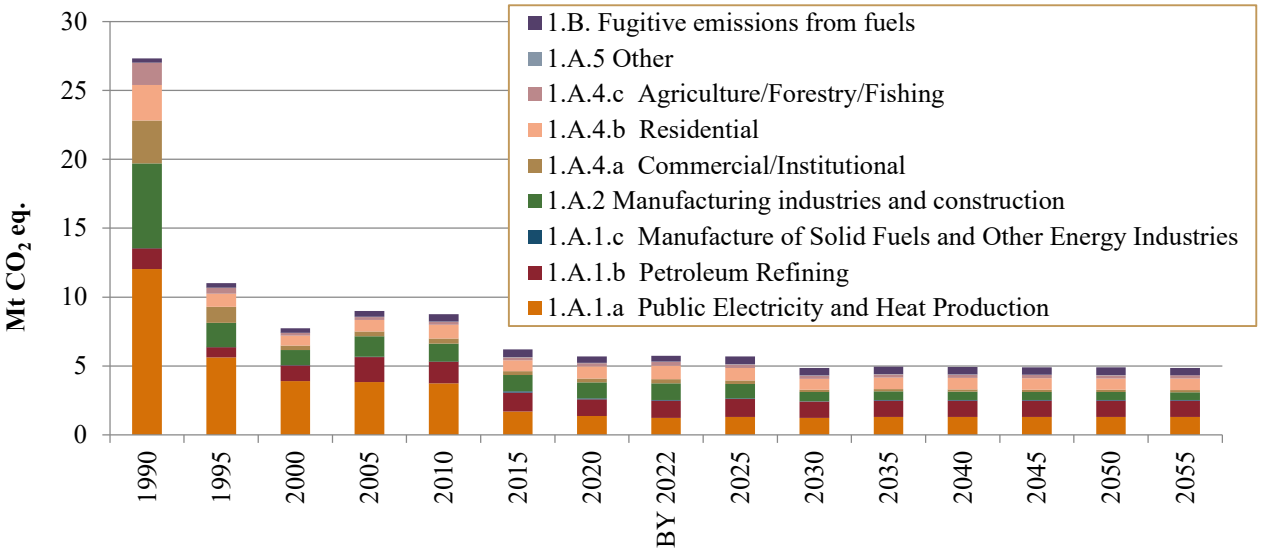

Figure 4-3. Historical and projected GHG emissions 1990–2055, kt CO_2 eq. (excluding transport sector)

It is estimated that the overall GHG emissions from energy sector (excluding the transport sector) will decrease by 82% in 2055 compared to 1990. Figure 4-4 shows the share of GHG emissions from each energy subsector in 2030.

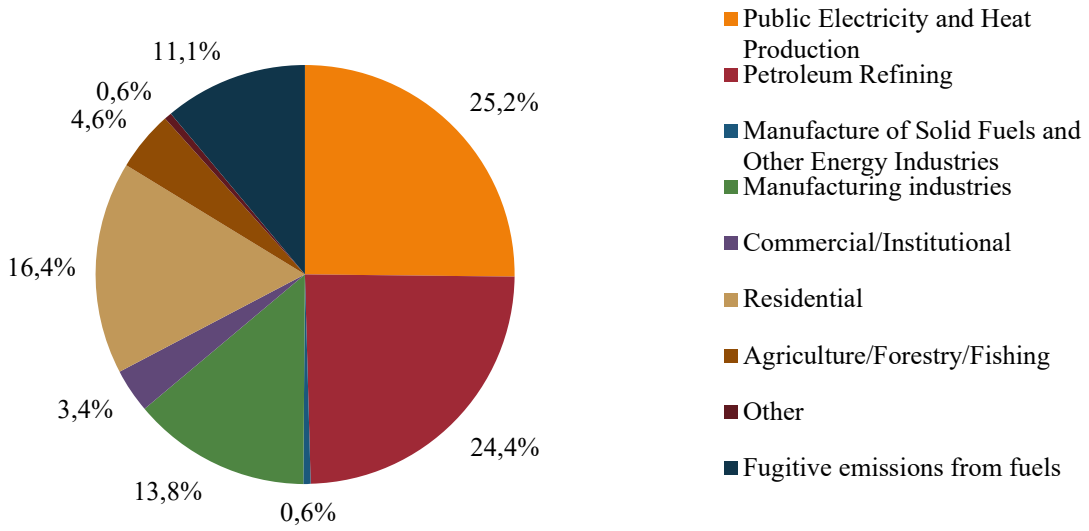

Figure 4-4. Estimated GHG emissions share by sectors in 2030

GHG emissions are estimated to reach a total of 4,862 kt CO_2 eq. in 2030. Most of the GHG will originate from public electricity and heat production (25%), petroleum refining (24%) and residential sector (16%). Manufacture of solid fuels and other energy industries as well as other (military aviation) sectors are still expected to remain the smallest GHG emitters of energy subsectors.

Several factors determine GHG emission projections in the EU ETS sectors and mainly in the public electricity and heat production sector. These sectors underwent a trend of switching fossil fuel to the

use of biomass up to 2024, but the result is still not seen in fuel balance. Emissions in public electricity and heat production sector shall also reduce up to 2030 due to the building renovation program. New biomass-fuelled CHP boilers started operation in Vilnius in July 2023. This reduces electricity imports for Lithuania and reduces GHG emissions in public electricity and heat production. For the current GHG projections it was assumed that the EU ETS carbon price will remain stable until 2055. Possible impact of carbon price on GHG emissions from the EU ETS sectors will be further investigated in sensitivity analysis chapter.

4.1.3.2 Scenario "with additional measures" (WAM)

The WAM scenario includes measures which pay the most attention to RES development, increasing energy efficiency and improving internal energy market.

Assessing the impact of additional PaMs in the energy sector, it is important to emphasize renovation of multi-apartment buildings, individual houses and non-residential buildings as well as the main foreseen jump of installed power in green hydrogen production – 996 MW of installed power will be built in the period of 2025–2030 in green hydrogen production plants which should generate about 76,700 t of hydrogen in 2030 and increase total RES share and RES share in transport.

The emissions from energy sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-2. *Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq.*

	2025	2030	2035	2040	2045	2050	2055
WEM scenario	5,688.14	4,861.53	4,954.90	4,921.58	4,906.99	4,890.60	4,875.32
WAM scenario	5,635.75	3,977.59	3,976.95	3,952.36	3,948.09	3,941.72	3,936.51
Difference	52.39	883.94	977.95	969.22	958.91	948.88	938.82
	1%	22%	25%	25%	24%	24%	24%

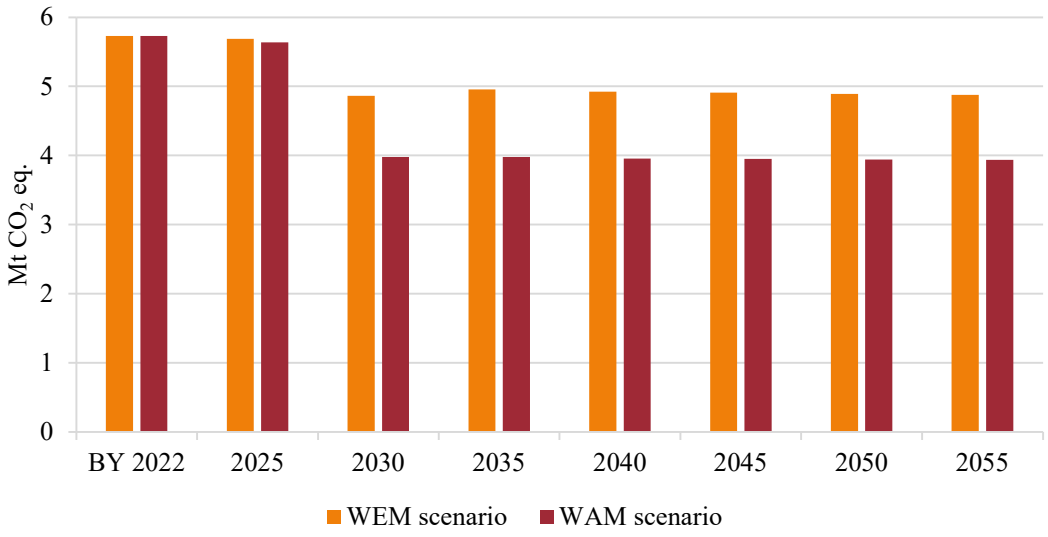

Figure 4-5. Projection of the WEM and WAM scenarios in the energy sector

4.2. Transport

4.2.1 Overview of the transport sector

The transport sector is the most important contributor to national GHG emissions in Lithuania. In 1990 transport sector accounted for 5,810.7 kt CO_2 eq. of the total national GHG emissions. In 2022 it amounted for 6,011.4 kt CO_2 eq. GHG emissions. The transport sector share in total GHG emissions increased from 1990 to 2022 by 19.6% and the overall emissions from this sector increased by 3.5%. This increase was mainly caused by the rapid increase of the density of transport routes, the volume of goods transported by road and the number of road vehicles (Figure 4-6).

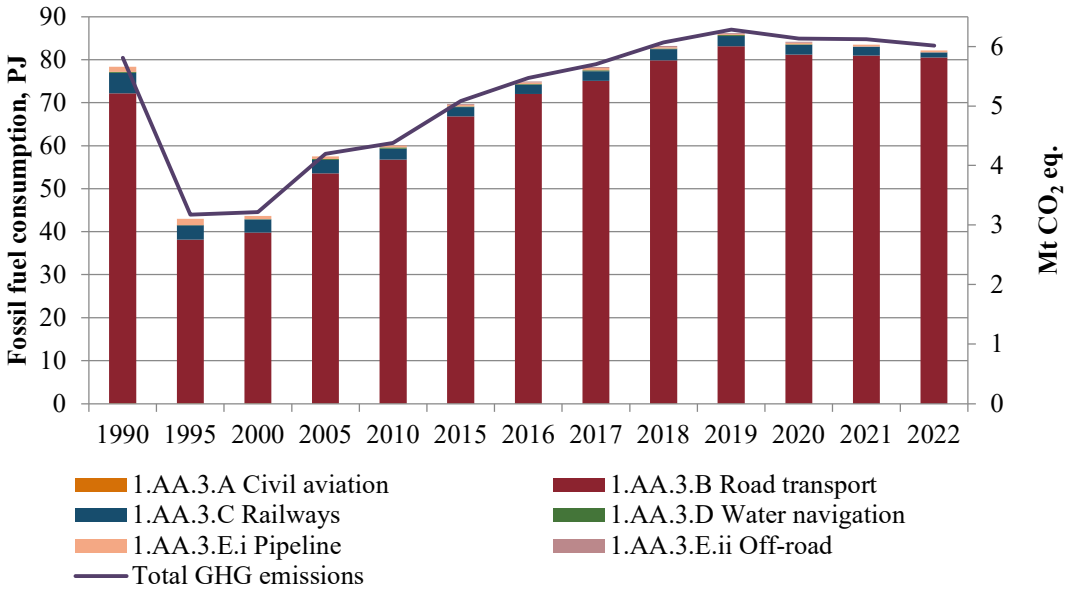

Figure 4-6. Fossil fuel consumption and GHG emissions trends in transport sector

GHG emissions decreased significantly from 1990 to 1995 because of the decline in fuel consumption (Figure 4-6). Once the economy started to grow, emission increased but this was partly compensated by the reductions achieved through energy efficiency and measures taken to reduce emissions.

GHG emissions and fuel consumption in transport sector are distributed into 5 main subsectors:

- *Civil aviation*. This subsector includes jet and turboprop powered aircraft (turbine engine fleet) and piston engine aircraft.
- *Road transportation*. This subsector includes transportation on roads by vehicles with combustion engines: passenger cars, light duty vehicles, heavy duty vehicles and buses, mopeds and motorcycles.
- *Railways*. This subsector includes railway transport operated by diesel locomotives.
- *Water-borne navigation*. This subsector includes merchant ships, passenger ships, container ships, cargo ships, technical ships, tourism ships and other inland vessels.
- *Other transportation*. This subsector includes transport of gases via pipelines and off-road transport used in ports for loading ships, various cranes and other means of transport.

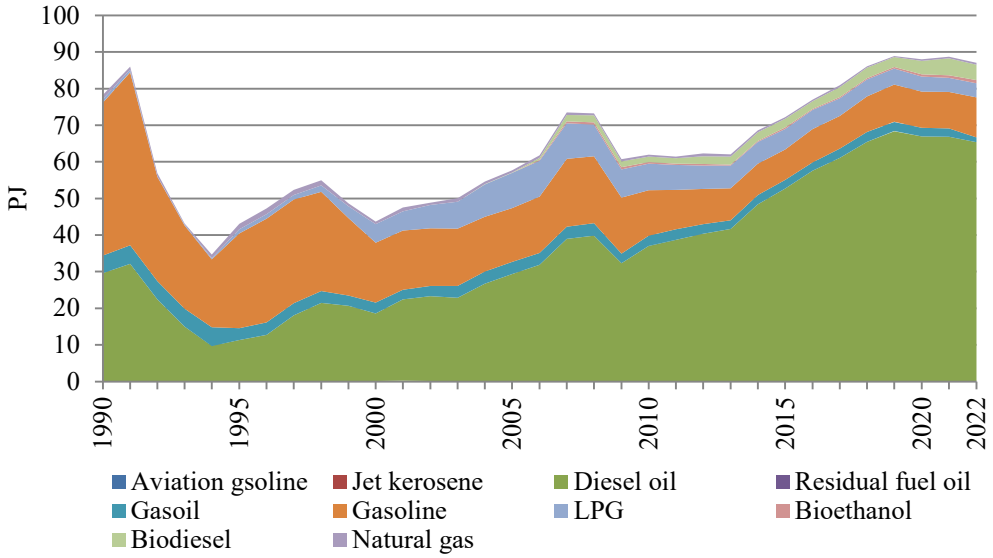

Figure 4-7. Fuel type share in total fuel consumption in transport sector

The main GHG emissions' contributor in the transport sector is the road transport subsector. In 2022 this subsector accounted for 97.5% (5,859.95 kt CO_2 eq.) of total GHG emissions from transport sector. During the period 1990–2022 diesel oil and gasoline were the main two fuel types combusted in the transport sector (Figure 4-7).

4.2.2. Methodologies and key assumptions

The projections were carried out by firstly determining the consumption of each fuel type in every subsector (civil aviation, road transportation, railways, water-borne navigation, other transportation) up to the year 2055. As the GHG emissions are directly linked to the fuel consumption through specific fuel emission factors, knowing the fuel consumption during the specific period enabled simplified calculation of the GHG emissions.

4.2.2.1. Scenario "with existing measures" (WEM)

The scenario "with existing measures" includes the national legislation documents that include projections of energy demand, climate change mitigation measures, projects currently in development and will be set in motion during the period 2022–2055.

The baseline scenario projections of the number of cars by fuel and energy type were calculated using regression analysis. Regarding number of freight transport vehicles and buses, baseline scenario projections were calculated using anticipated data of goods transport and passenger transport by road, respectively, obtained from the study "Assessment of the effectiveness of measures to reduce greenhouse gas (GHG) emissions in the transport sector and modelling of forecasts", prepared by JSC "Smart Continent"[7]. Then, using anticipated number of transport vehicles, their average kilometrages (obtained from association of technical vehicle inspection companies) and fuel consumption per kilometre, anticipated fuel consumption was calculated by type of road vehicle and fuel. JSC "Lietuvos geležinkeliai" provided the required activity data for the estimation of projections in the railway sub-sector. The Ministry of Transport and Communications of Lithuania provided the activity data (fuel consumption) for the estimation of projections in the civil aviation sub-sector, therefore the GHG emissions were calculated by applying the specific fuel emission factors used in NID (2024).

7 https://sumin.lrv.lt/uploads/sumin/documents/files/Transporto%20priemoniu%20SESD%20vertinimas%2020210610.pdf

Domestic civil aviation is essentially narrow (0.03% of GHG emissions in transport) in Lithuania. Aviation gasoline (avgas) is used for piston-type powered aircraft engines, while the jet fuel is used in turbine engines for aircraft and diesel engines. Aviation gasoline as a fuel is more common in private aircraft, while jet fuel is used in airlines and other large aircraft. The anticipated fuel consumption for aircrafts used for civil international flights is provided in Table 4-3.

Table 4-3. *Anticipated fuel consumption in international aviation (t)*

Fuel type	BY 2022	2025	2030	2035	2040	2045	2050	2055
Aviation gasoline	0	0	0	0	0	0	0	0
Jet kerosene	98,320	107,213	127,718	133,403	139,087	145,277	151,467	157,656

Baseline projection of GHG emissions in the railway sub-sector was carried out by using data received from the railway operator JSC "Lietuvos geležinkeliai". WEM scenario fuel consumption projection, calculated by including impact of existing measures from data provided by the company, is shown in Table below.

Table 4-4. *Anticipated fuel consumption in railways subsector (TJ)*

Fuel type	BY 2022	2025	2030	2035	2040	2045	2050	2055
Diesel oil	1,142	988	615	615	615	615	615	615
Biodiesel	78	97	148	148	148	148	148	148

No other measures were applied for determination of fuel consumption in railways subsector therefore the GHG emissions were calculated by applying the specific fuel emission factors used in NID (2024).

The water borne navigation is composed of navigation through the inland waterways: navigable rivers, canals, lakes, man-made water bodies, and part of the Curonian Lagoon belonging to the Republic of Lithuania. In 2022 the GHG emissions from domestic navigation accounted for 9.7 kt CO_2 eq. Projection of GHG emissions in water borne navigation subsector was carried out by using data received from the Ministry of Transport and Communication, but the data was obtained only from Klaipėda's ferry between Curonian lagoon and the mainland. Other part of consumed fuel was assumed to remain unchanged in domestic navigation in WEM scenario. One measure was applied in projection of GHG emissions from water borne navigation subsector ("Promoting sustainable inland shipping"), aiming at renewing the existing fleet for the management of inland waterways through the acquisition of an electric pusher craft, a non-self-propelled barge and an electric crane (2024–2025). GHG emission projections for international navigation were based on anticipated ship loading in Klaipėda harbour up to 2024. From 2025 to 2040, GHG reductions (%) from the Feasibility Study Project Report[8], table 1.2 (p. 15) were used. From 2041, the projections were carried out on the assumption that the GHG emissions from navigation sector should be reduced by 40% by 2050, compared to 2005 level.

Road transportation is the most important GHG emissions source in the transport sector. This sector includes all types of vehicles on roads (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles, mopeds). GHG emissions from road transport subsector accounted for 5,859.9 kt CO_2 eq. in 2022.

Baseline scenario GHG emissions from Road transport calculation was based on the change of vehicle number which was forecasted using regression analysis (for passenger cars and motorcycles) and using the anticipated change of tonne-kilometres or passenger kilometres in public transport for cargo

[8] https://sumin.lrv.lt/media/viesa/saugykla/2024/1/s_xfEW3iD7k.pdf

vehicles and buses according to the study performed by JSC "Smart Continent"[9]. Using a distribution of cars by power source in 7 historical years, a forecast of the breakdown of the passenger car fleet by a power source was calculated for baseline scenario. Baseline projections of numbers of cargo vehicles were created proportionally to the growth of the projected tonne-kilometres in road transport, and projections of buses were created considering projected passenger kilometres in public road transport. The obtained numbers of vehicles were then combined with kilometrages, fuel consumption per kilometre and GHG emission factors to produce projected emissions. Fuel consumption per kilometre was assumed to be by average 4% lower in 2030 than it was in 2021 for the whole vehicle fleet.

Additionally, the support from EU funds to municipal administrations for purchasing low-emission urban public transport vehicles (EU-funded instrument for 2014–2020, continued up to 2030) provided funding for acquisition of environmentally safe buses. It is estimated that introduction of these buses will reduce GHG emissions from the road transport sector by 5.7 kt CO_2 eq./year. Total GHG emission reduction by 2029 will amount to 35.6 kt CO_2 eq.

For buses and other heavy-duty vehicles, establishment/development of charging/refuelling infrastructure for alternative fuels (electricity, biogas and hydrogen) is being implemented. 30 biogas, 4 hydrogen and 300 charging stations for heavy transport are foreseen to be installed by 2027. It was estimated that this activity will additionally generate nearly 4,500 alternative fuel or energy powered vehicles by 2030, and this will reduce GHG emissions by 121.6 kt in that year.

Moreover, promoting the purchase of electric cars and electric car charging infrastructure together should significantly increase the number of electric cars in Lithuania. It was estimated that such activities as "Promoting the purchase of battery electric cars", "VAT deductions for EV purchases", "Development of private EV charging infrastructure", "Compensation for connection of charging infrastructure to the electricity grid" and "EU legal and regulatory obligations for the development of charging infrastructure" under the Regulation 2023/1804/EU should have the largest impact for GHG reduction (in total 214,6 kt CO_2 eq. in 2030).

According to the Law of alternative fuel, a yearly sum of gasoline and diesel oil supplied to Lithuanian market by a fuel supplier must contain an increasing part of fuel from renewable energy sources: form at least 6.8% in 2022 to at least 16.8% in 2030 by energy value.

Financial incentives are provided for persons who transferred its property rights of a car to a waste handler in Lithuania. The incentive is flat-rate compensation which can be used to purchase an electric scooter, moped, bicycle or a used or new passenger car that meets low levels of emission criterion. This measure should reduce CO_2 eq. emissions by 13.8 kilotons by the year 2025.

E-tolling for freight transport is going to apply differentiated "user pays" and "polluter pays" principles to freight transport. Since fuel consumption for heavy duty transport does not decrease when the Euro standard increases, the direct effect is seen only on those companies who switch from conventional (non-Euro) vehicles into meeting Euro standards ones. However, as the tax is paid for every kilometre driven, carriers should plan optimal routes and decrease their kilometrage. Additionally, a lower tax rate is planned for electric and hydrogen-powered trucks, so it is expected that some of the trucks will be changed to the mentioned ones. All in all, it is estimated that this measure should reduce fuel consumption of heavy-duty transport by 928.9 TJ in 2030.

9 https://sumin.lrv.lt/uploads/sumin/documents/files/Transporto%20priemoniu%20SESD%20vertinimas%2020210610.pdf

Formation and promotion of eco-driving skills impacts drivers in all modes of road transport: cars, freight transport and buses. It is assumed that the GHG reduction impact of promotion of eco-driving in road transport is 3.2 kt CO_2 eq./year. Later, when an E-learning platform is created, the impact is estimated to be by average 5 kt CO_2 eq./year starting from 2026, and in 2030 the effect should reach 38 kt CO_2 eq.

An ambitious measure is investment support for biomethane plant facilities, providing priority for transport to use biomethane. Under these conditions, there is an assumption that all gas-powered public transport will run on a biomethane. It is evaluated that yearly demand in transport will be 3,211 TJ of biomethane by 2030 and this will reduce GHG emissions by 178.3 kt CO_2 eq. in the transport sector in that year.

The measure "Renewal of transport fleet by using green public procurement for transport" is dedicated to implement the objectives provided in the Directive of European Parliament and Council (EU) 2019/1161, however, the objectives provided in the Law of alternative fuel are more ambitious than they are in the mentioned Directive.

Higher fuel excise tax and an additional CO_2 component in fuel prices will have a large effect for GHG emission reduction. It is implemented by amending the Law of Excise Duties. It is evaluated that, when implementing this measure, the price for one liter of diesel oil will increase by almost 0.3 euro (approximately 19%) by 2030 and the measure should reduce GHG emissions by 196 kt CO_2 eq. in transport in 2030. EU emission trading system for transport will additionally rise fuel prices and this should have additional GHG emission savings.

Policy measures in transport were assessed based on the extent of each measure as provided by the authorities responsible for the measures, e.g. the number of non-polluting cars to be supported, the amount of freight to be transferred to rail, etc. These quantities were multiplied by average multipliers to calculate fossil fuel and energy savings and multiplied by GHG emission factors to calculate GHG savings. Soft and infrastructure improvement measures in transport have been assessed based on studies or expert assumptions. Fiscal measures and incentives (T6-E "Car Registration Tax", T8-E "Electronic Tolls in Freight Transport", T27-E "Law on Excise Duties" and T28-E "Implementation of ETS2") have been calculated using price and fuel elasticities (including the new EU ETS2). For the new EU ETS2 measure (T28-E), it was assumed that the price of an emission allowance in this scheme would increase from 25 €/t CO_2 in 2027 to 50 €/t CO_2 in 2030. This price has been converted into a direct increase in the fuel price (EUR/1000 litres) for each fuel. As there is a wide variety of policy measures in the transport sector, the methodology for their assessment also varies and for some of the measures a specific methodology has been developed for one specific measure only.

The GHG emissions from natural gas transportation in the pipelines category in 2023 were estimated by adding up anticipated natural gas consumption provided by their transmission operator and the calculated consumption of their distribution operator. Emissions from 2024 were estimated according to the projected gross consumption of natural gas obtained from the modelling of the energy sector and from industrial company regarding non-energy use. The GHG emissions from this category have significantly increased due to the new gas interconnection Poland-Lithuania (GIPL).

4.2.2.2. Scenario "with additional measures" (WAM)

Additionally, it is estimated that measures for developing domestic navigation (especially "Construction of new cargo vessels and barges") should reduce GHG emissions by 26.5 kt CO_2 eq. by 2030.

Compared to WEM scenario, WAM has an objective to additionally reduce actual amount of fuel consumption and to implement fuel-switch measures. A rapid decrease of diesel oil consumption is planned which is sought to be partly changed by biomethane and hydrogen use as well as electrification. However, due to additional biomethane demand in transport and high methane emission factor from gaseous fuel consumption in road transportation, methane emissions from road transportation in WAM scenario are higher than in WEM scenario, and this can be seen in Annex XXV Table 1a when comparing the scenarios from year 2028.

A lot of measures together contribute to the increase of the number of electric cars and cover such aspects as an additional CO_2 component in fuel prices (already existing measure), continued higher subsidies for their acquisition, development of the recharging infrastructure (already existing measure) and lectures about sustainable mobility. An absence of any of these aspects would significantly reduce the planned number of electric cars, e.g., there wouldn't be any possibility of subsidizing the acquisition of electric cars in the absence of CO_2 components in fuel price, and electric cars would not be attractive if there was poor infrastructure. These measures contribute to other existing measures promoting electric cars: an ability to use specially marked public transport lines in Vilnius, exemptions for car parking and entrance fees in Lithuanian towns, registration charge according to the level of pollution, subsidies for acquisition of electric cars, raising public awareness, creation of low pollution areas in towns and EU emission trading system for transport. Only measures T1 "Promoting the purchase of electric cars" and T13-E "Electric car charging infrastructure" are intended to namely increase the number of electric cars – all other measures reduce GHG emissions in other ways, too.

Additional policy measures T1-P "Promoting the purchase of electric cars" and T2-P "Promoting alternative fuels vehicles" were evaluated considering the number of vehicles to be replaced and the average fuel consumption of one vehicle to be replaced; T2-P "Promotion of the development of refuelling infrastructure for alternative fuel (hydrogen)" was assessed taking into account the number of hydrogen refuelling points built and survey data on the proportion of the population encouraged to switch between vehicles considering only infrastructure development, T2-P "Digital solutions for optimising freight flows and reducing empty mileage" was assessed according to the number of digital subscriptions, the average share of empty lorry mileage and the savings achieved by subscribing digital solution, T4-P "Promoting intermodal transport" was assessed considering the transfer of freight traffic to electrified railway sections and the average fuel consumption per tonne-kilometre, T25-P "Developing electricity supply at seaport" was assessed in accordance with the annual berthing time of different types of vessels and their diesel consumption per hour, and T26-P "Developing sustainable airport infrastructure" was assessed considering the amount of fuel used in domestic aviation and the share of this fuel that will be replaced by sustainable aviation fuels.

Continued promoting alternative fuels infrastructure and vehicles will have the largest effect for GHG emission reduction. New biomethane, electricity or hydrogen powered heavy duty vehicles could additionally be purchased by 2030: 1,478 buses and 1,768 cargo vehicles. It is also evaluated that, when implementing other activity of this measure, 6,750 trucks could apply digital solutions for the empty mileage reduction and reduce their empty mileage by 30%. In total, the measure should reduce GHG emissions by 97.2 kt CO_2 eq. in 2030. Promoting intermodal transport will additionally reduce fossil fuel consumption in freight transportation on roads and this should have additional GHG emission savings.

4.2.3. Projections of GHG Emission

4.2.3.1. Scenario “with existing measures” (WEM)

This chapter will overview the projected GHG emissions results in the transport sector according to scenario “with existing measures”.

The road transport sector is the main source of GHG emissions and fuel consumption in transport sector. It was assumed that GHG emissions in road transport sector are directly linked with fuel consumption which is influenced by the number of fossil fuel powered road vehicles registered in Lithuania, their kilometrage and fuel consumption per kilometre. The total projected number of cars registered in Lithuania was calculated using regression analysis for baseline scenario. This number of cars is anticipated without measures with the start of implementation in 2021 or later, therefore impacts of these new measures were additionally included in calculations of number of cars and anticipated fuel consumption of WEM scenario. It was projected that the total number of road vehicles with internal combustion engine (including passenger cars, light and heavy-duty vehicles) will reach only 623,608 units in 2055 (Figure 4-8). Number of vehicles with internal combustion engines (ICE) is expected to decrease together with total emissions in road transportation. After 2030, number of vehicles with ICE decreases relatively faster than GHG emissions, as higher proportion of heavier cargo vehicles with ICE is expected to be in the fleet.

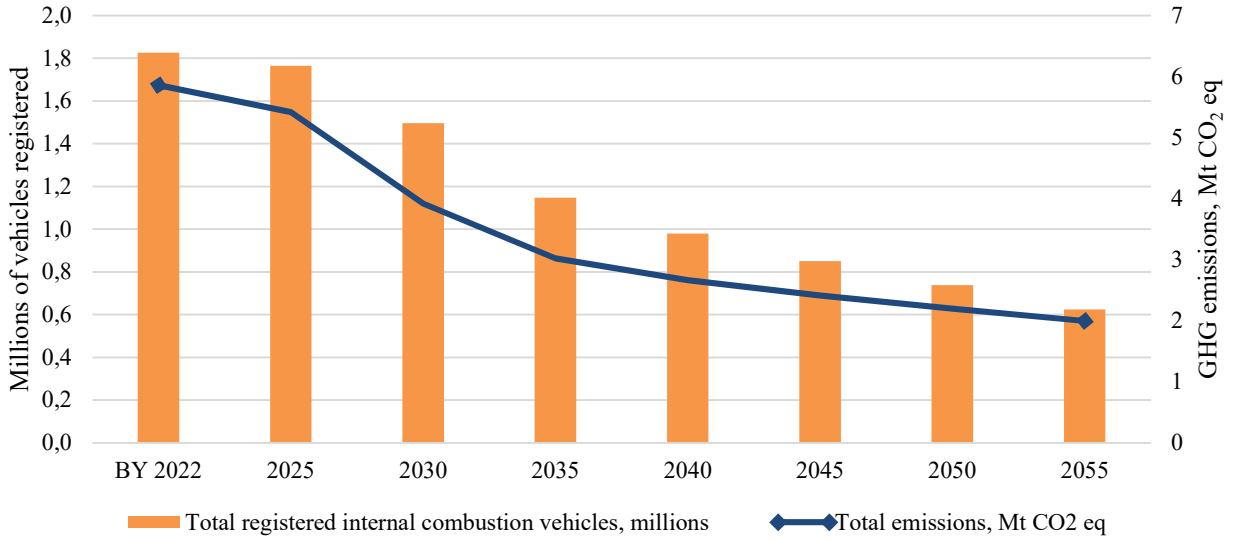

Figure 4-8. Projected number of vehicles registered and GHG emissions in the road transport sector

Road transport sector is projected to remain the only gasoline and the main diesel oil consumption source in transport sector. According to the projected data, the gasoline consumption in this sector will decrease by 31% and diesel oil consumption will decrease by 71% by 2055 (Figure 4-9). The fuel consumption in road transport shall decrease from 85,291 TJ in 2022 to 36,350 TJ in 2055.

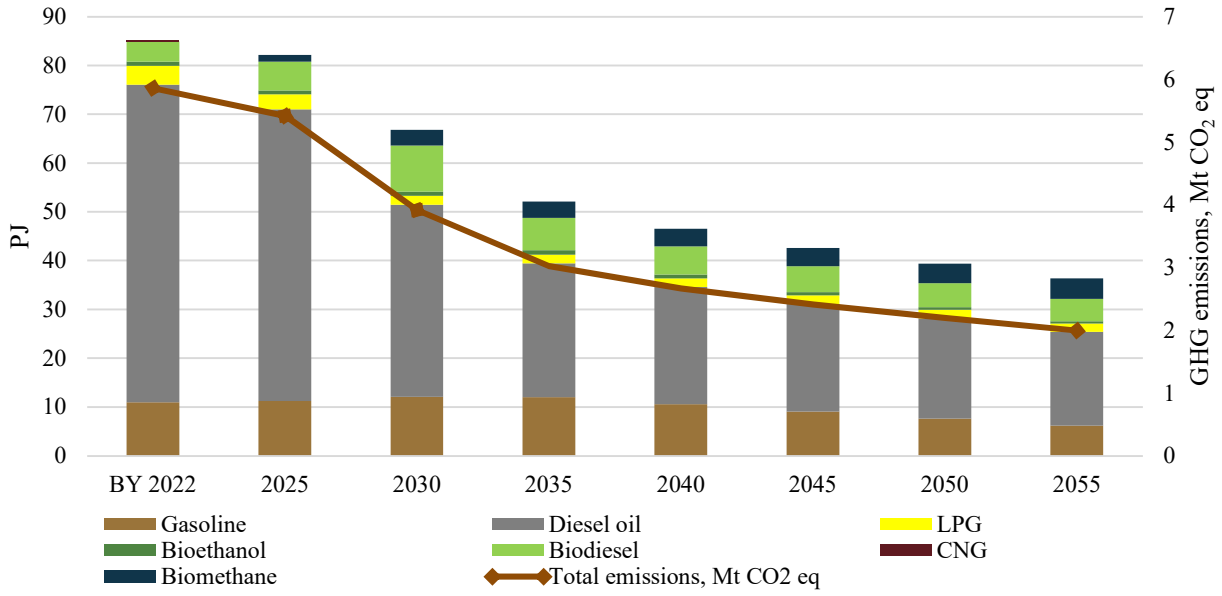

Figure 4-9. Projected fuel consumption and GHG emissions in the road transport sector

The main fuel used in transport sector will remain diesel oil (51% in 2055) (Figure 4-10). Road transport sector is projected to remain the only gasoline and the main diesel oil consumption source in transport sector. Road transport will remain the main fuel consumer in transport sector. As a result, it will remain the main GHG emissions source in this sector (97% of total transport sector emissions) in 2030. This is a result of increased vehicle number in Lithuania and the ongoing electrification of railways. It is projected that diesel oil and gasoline will remain the main fuel used in transport sector. This is mainly influenced by the fuel use trend in road transport sector.

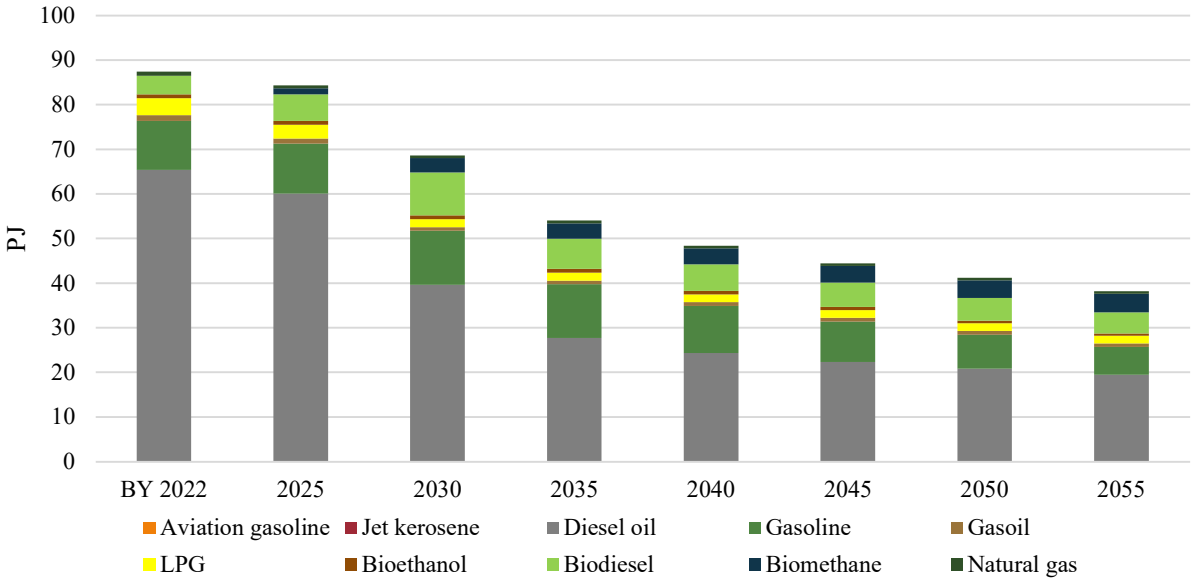

Figure 4-10. Projected total fuel consumption in the transport sector

GHG emissions from transport sector are projected to decrease down to 4,038 kt CO_2 eq. in 2030 (Figure 4-11). Compared to 2022, the GHG emissions from this sector will decrease 1.5 times in 2030. The decrease of GHG occurs due to the implementation of existing GHG reduction measures, due to increasing energy efficiency in road transport and due to decreasing population.

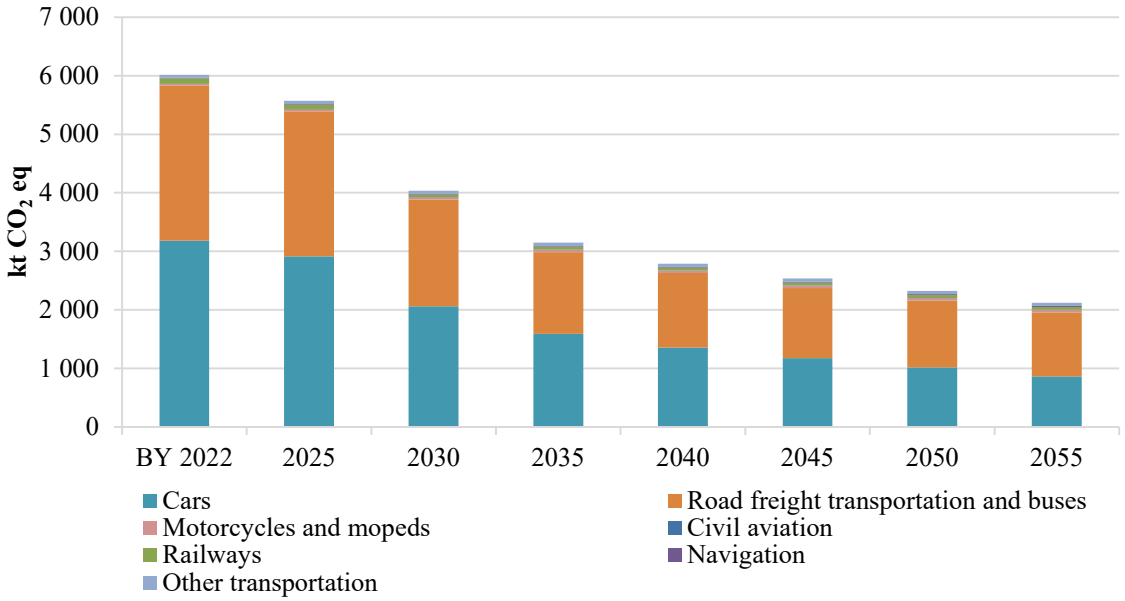

Figure 4-11. Projected total GHG emissions in transport sector

The second largest GHG emissions source in transport sector will remain railways sector. In civil aviation subsector it is estimated that the GHG emissions would not change until 2030, and this sector will remain a minor source of GHG emissions as there are only 9 aircraft operators[10] that have valid license issued to perform air communication in Lithuania. Most of the flights performed by the Lithuanian aircraft operators are international and are excluded from the projections for the national total.

Railways sector is projected to emit less amount of GHG in 2030 (50 kt CO_2 eq. – decreased by 46% compared to 2022). This is because the fuel consumption in railways would decrease by 37.5%, influenced by electrification of railways. An additional reason for the reduction of GHG emissions in railways is an obligatory higher share of biofuel blended in gas/diesel oil required by the Law of alternative fuels.

Transport sector is less affected by the EU ETS carbon price as in current situation only aviation, navigation sectors and pipeline transportation companies are involved in the EU ETS market. In Lithuania there are several aircraft operators that fall under the scope of the EU ETS and according to the latest data from EUROCONTROL[11] only two aircraft operators were not considered as small emitters in 2023 (emitted 11,492 t CO_2 per year under EU ETS).

4.2.3.2. Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of Environment, the Ministry of Transport and Communications, the Ministry of Energy and the Ministry of Agriculture. The implementation period of measures will cover period of 2025–2030. For the period of 2031-2055 all additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focus on incentives to change vehicles to the ones powered by alternative sources (electricity, biomethane, hydrogen), also on fuel-efficiency (combined intermodal

[10] Lithuanian transport safety administration data: https://ltsa.lrv.lt/lt/veiklos-sritys/oro-transportas-1/licencija-oro-susisiekimui-vykdyti/informacijos-apie-licencijas-vykdyti-oro-susisiekima-skelbimas/
[11] European Organisation for the Safety of Air Navigation https://www.eurocontrol.int/

transport, sustainable mobility, etc.). Promoting alternative fuels infrastructure and vehicles together with promotion of intermodal transport will have the largest effect for GHG emission reduction.

The emissions from transport sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-5. *Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq.*

	2025	2030	2035	2040	2045	2050	2055
WEM scenario	5,571.02	4,037.53	3,151.28	2,790.49	2,534.73	2,320.95	2,119.85
WAM scenario	5,514.42	3,847.07	2,943.25	2,564.96	2,291.71	2,060.45	1,859.34
Difference	56.60	190.46	208.03	225.53	243.02	260.50	260.51
	1%	5%	7%	9%	11%	13%	14%

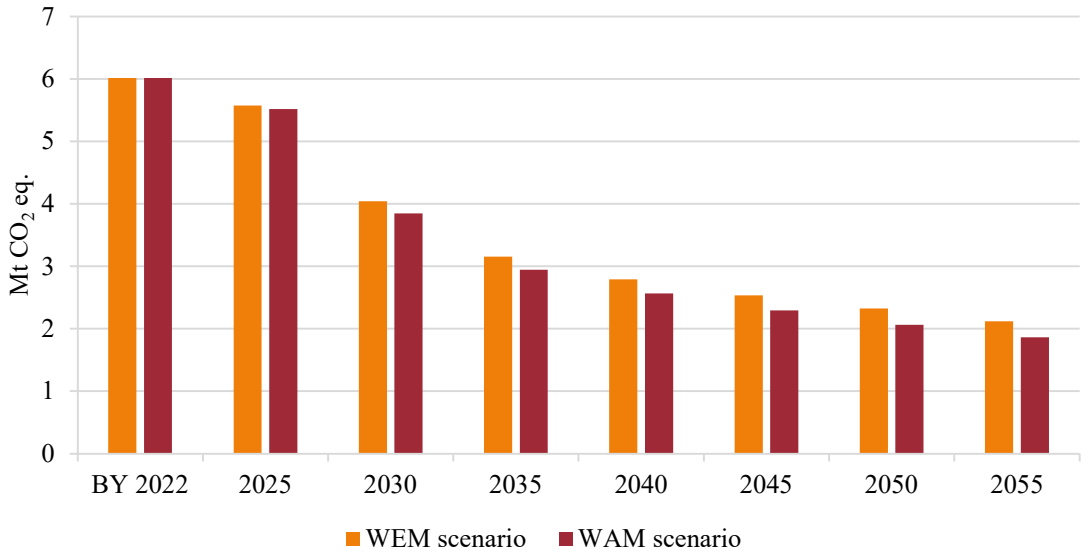

Figure 4-12. Projection of the WEM and WAM scenarios in transport sector

4.3. Industrial processes and product use

4.3.1. Overview of the industrial processes and product use sector

Lithuanian industrial processes and product use (IPPU) sector accounts for a significant share of gross value added in the country's economy. Division of the country's economy as per the classifier of economic activity indicates that on the first level, the industry consists of four activities: manufacturing; extracting (mining and quarrying); supply of electricity, gas and steam; supply of water, sewerage, waste management and remediation activities. After the economic recession in the early 1990s, Lithuania's industrial production and economy started to grow, as reflected by the GDP growth. Lithuania was struck by the global economic crisis causing a significant reduction in industrial production in 2009. From 2010 the country economy started to recover, which led to an increase in the industrial production (Figure 4-13).

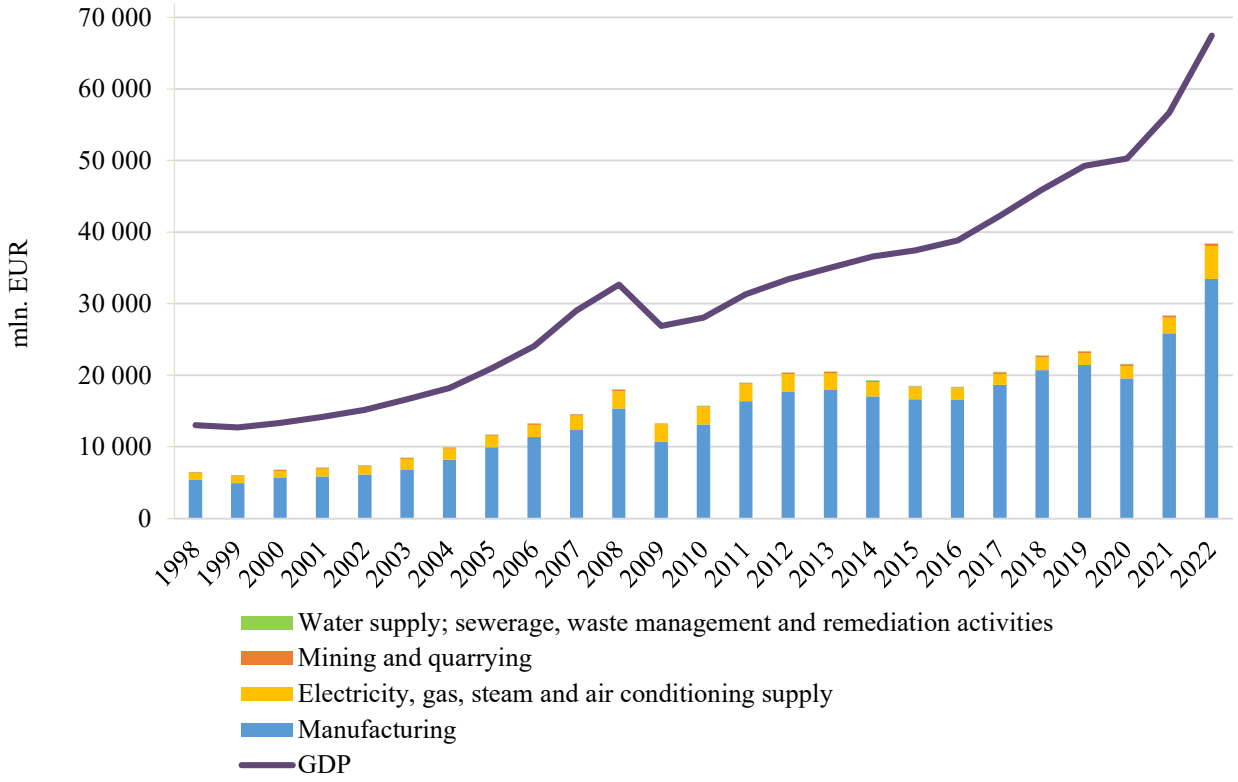

Figure 4-13. Industrial production (except construction) and GDP during production at constant prices[12]

Dominating industry in Lithuania is manufacturing. Manufacturing constituted 87% of the total industrial production (excluding construction) in 2022.

In 2022 four most important subsectors within manufacturing cumulatively produced 64% of production:

- manufacture of refined petroleum products (21%);
- manufacture of food products and beverages (15%);
- manufacture of wood products and furniture (16%);
- manufacture of chemicals and chemical products (12%).

GHG emissions from IPPU amounted to 11.8% of the total GHG emissions (excl. LULUCF) in 2022, totalling 2,320.2 kt CO_2 eq. Emissions from IPPU include CO_2, N_2O and fluorinated gases (F-gases – HFCs, SF_6 and NF_3) emissions. Emissions of total GHG from the industrial processes and product use sector have decreased by 29% since 1990 (Figure 4-14).

[12] https://osp.stat.gov.lt/statistiniu-rodikliu-analize#/

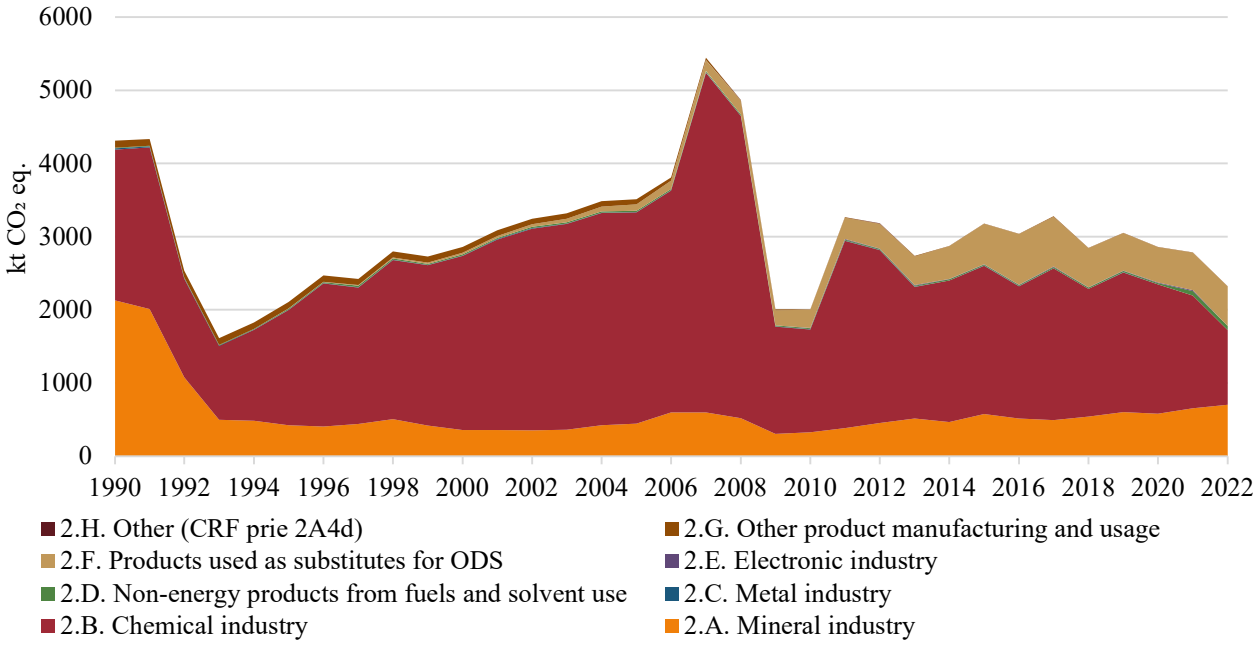

Figure 4-14. GHG emissions in IPPU sector in 1990–2022

Main sources responsible for the highest emissions in IPPU sector are ammonia production (CO_2), nitric acid production (N_2O), cement production (CO_2) and F-gases use in refrigeration and air conditioning equipment (HFCs).

Emissions of chemical industry in 2022 were 1,019.3 kt CO_2 eq., and it was 43.9% of IPPU sector emissions. CO_2 emissions from ammonia production contributed 7.2% to the total national CO_2 emissions (excl. LULUCF) in 2022. The lowest emission of CO_2 was in 1993 due to decrease of the ammonia production and the peak of CO_2 emissions were in 2007 when the ammonia production increased. Comparing with 2021 ammonia production in 2022 decreased by 39.9% and CO_2 emissions decreased by 33.8% in 2022.

Nitric acid production is the main source of N_2O emissions in the IPPU sector. Nitric acid is produced in a single company and accounted for 4% in the total national N_2O emissions (excl. LULUCF) in 2022. N_2O emissions had been increasing since 1995 and reached its peak in 2007. After the installation of the secondary catalyst in nitric acid production enterprise in 2008 the emissions of N_2O dropped drastically till 2010 and started to increase because of the increase of production capacity. From 2011 emissions began to decrease because the project (Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant Fertiliser Factory) of catalyst installation has been finished. Comparing with 2021 nitric acid production in 2022 decreased by 22.9% and N_2O emissions decreased by 34.4%.

Emissions of the mineral industry were 703 kt CO_2 eq. in 2022, and it was 30% of the IPPU sector emissions. Cement production is the biggest source of GHG emissions in the mineral industry being 682 kt CO_2 eq. (97%). Portland cement is produced in a single company, which produces more than 1 million tonnes of Portland cement per year.

In 2022 the emissions from consumption of F-gases were estimated at 535 kt CO_2 eq. (24% from the aggregated emissions from IPPU sector). The main sources of HFCs emissions are commercial refrigeration, industrial refrigeration, transport refrigeration and mobile air-conditioning. Emissions from equipment in those sectors cover up to 88% of the total F-gases emissions in 2022. Emissions from commercial refrigeration and industrial refrigeration equipment account respectively for 32%

and 6%, from mobile air-conditioning and transport refrigeration account for 31% and 13% of the total Lithuanian F-gases emissions in 2022. The rest F-gases are emitted from stationary air conditioning, domestic refrigeration, foam blowing, fire extinguishers and other F-gases containing equipment such as electrical equipment, metered dose inhalers etc. (about 12%).

4.3.2. Methodology and key assumptions

The GHG emissions projections from IPPU sector with existing PaMs were estimated using projected production levels data (activity data) by 2055 provided by the main emitters in this sector: clinker, glass, ammonia and nitric acid producing companies. Emissions from these industries covered up about 76% of total IPPU sector emissions in 2022.

The projections of GHG emissions were estimated by applying emission factors, which were calculated according to Methodological guidance for the preparation of National GHG projections guidelines prepared by Lithuanian Energy Institute in 2016. The emission factors are presented in the table below.

Table 4-6. *Emission factors (EF) in IPPU sector (t CO_2 eq./t production)*

Industrial Processes	EF
Clinker production, t/t	0.532
Lime production, t/t	0.782
Glass production, t/t	0.091
Mineral wool production, t/t	0.153
Nitric acid production, t/t	0.00047
Lubricant use, t/TJ	0.590
Paraffin wax use, t/TJ	0.590
Solvent use, t/thous. inhabitants	0.014

Projections of CO_2 emissions arising from ammonia production are calculated using projected natural gas consumption data and applying the 2006 IPCC Guidelines[13] Tier 3 method, which states that CO_2 recovered for downstream use in urea production must be subtracted from the total quantity of CO_2 generated from ammonia production. While EU ETS emissions are estimated according to data provided by the companies where CO_2 recovered for downstream use in urea production are not subtracted from the total quantity of CO_2 generated from ammonia production. These differences in methodologies lead to differences in estimated total GHG and EU ETS emissions in the chemical industry.

All projected data were available for the 2022, 2025, 2030, 2035, 2040, 2045, 2050 and 2055. The data in between were interpolated. The base year for the GHG IPPU projections is 2022.

F-gases emission projections are performed at the same subcategory level as in Lithuanian GHG inventory using 2006 IPCC Guidelines emission factors. The WEM projection scenario for F-gases are generally based on the assumptions from Annexes III and V (Table 4-7) of F-gases Regulation (EU) No 517/2014[14], that creates bans, controls on the use and emissions of F-gases and EU MAC

[13] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_3_Ch3_Chemical_Industry.pdf

[14] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

Directive[15], which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2017.

Table 4-7. *Percentage to calculate the maximum quantity of hydrofluorocarbons to be placed on the market (based on Annex V of Regulation (EU) No 517/2014)*

Years	Percentage to calculate the maximum quantity of HFCs to be placed on the market and corresponding quotas
2015	100%
2016–2017	93%
2018–2020	63%
2021–2023	45%
2024–2026	31%
2027–2029	24%
2030	21%

Summary table of assessed emissions from IPPU sector, methods applied, and emission factors are provided in the table below.

Table 4-8. *Methods and emissions factors used to estimate emission from IPPU sector*

CRF	Source	Emissions reported	Methods	Emission factor
2.A	Mineral Industry	CO_2	Tier 1, Tier 2	PS, D, CS
2.B	Chemical Industry	CO_2, N_2O, CH_4	Tier 1, Tier 3	PS, D, CS
2.C	Metal Industry	CO_2	Tier 2	D
2.D	Non-energy products from fuels and solvent use	CO_2	Tier 1	D, CR
2.E	Electronics Industry	SF_6, NF_3	Tier 2, Tier 3	PS
2.F	Product uses as substitutes for ozone depleting substances	HFCs	Tier 1a, Tier 1b, Tier 2	PS, D, CS
2.G	Other product manufacture and use	SF_6, N_2O	Tier 1, Tier 3	D, CS, OTH
2.H	Other Production	CO_2	Tier 1	D

4.3.2.1. Scenario “with existing measures” (WEM)

Chemical Industry

The primary GHG emissions source in the IPPU sector remains nitric acid and ammonia production. Based on data from chemicals producing company (Table 4-9), the GHG emissions trends for 2025-2055 will decrease due to planned GHG reduction projects.

Table 4-9. *Base year and planned ammonia and nitric acid production, natural gas consumption volume*

Planned production	BY 2022	2025	2030	2035	2040	2045	2050	2055
Ammonia production, kt	1,090	2,382	2,382	2,382	2,382	2,382	2,382	2,382
Nitric acid production, kt	731	1,319	1,319	1,319	1,319	1,319	1,319	1,319

Mineral Industry

[15] Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

The mineral industry's projected emissions are based on industrial companies' projections considering implemented best available technologies according to companies' environmental permits.

A significant share of GHG emissions in mineral industry sector belongs to the CO_2 emissions from cement production. In 2013 company finished cement production modernization project, where wet cement production was transformed to dry cement production process. It was planned that the transition will allow reducing CO_2 emissions (including emissions from fuel combustion) by quarter: wet production process – 1.2 t CO_2/t of clinker, dry production process - 0.85 t CO_2/t of clinker[16].

The projections of CO_2 emissions from clinker production were based on activity data provided by the company (Table 4-10). It is assumed that projected clinker production from 2022 clinker production volume will remain stable until 2055.

Table 4-10. *Base year and projected volume of mineral industry (kt)*

Planned production	BY 2022	2025	2030	2035	2040	2045	2050	2055
Clinker production	682	593	593	593	593	593	593	593
Lime production	1.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Glass production	45	49	49	49	49	49	49	49
Mineral wool production	83	92	94	96	98	98	98	98

The projections of CO_2 emissions from glass production and mineral wool production were based on activity data provided by companies' authorities.

Product uses as substitutes for ozone depleting substances (ODS)

Emissions from 2.F. category (HFCs) were calculated applying the 2006 IPCC Guidelines Tier 1a, Tier 1b and Tier 2 methods using plant specific, default and country specific emission factors. The assumptions used for HFC emission projections are as follows:

- Commercial Refrigeration (2.F.1.a): a ban on the use of HFCs with GWP of more than 2500 in new commercial equipment since 2020 and with GWP of more than 150 since 2022. The average lifetime of equipment - 15 years.
- Domestic Refrigeration (2.F.1.b): HFCs with GWP of more than 150 in domestic refrigeration were phased out since 2015 and only emissions from stock (old equipment) and disposal will occur. The average lifetime of the refrigerator and freezers is 20 years.
- Mobile AC (2.F.1.e): a ban on the use of F-gases with GWP of more than 150 in new types of cars and vans produced from 2017. It is assumed, that the average lifetime of cars and vans is 17-24 years (depending on vehicle category).
- Transport Refrigeration (2.F.1.d): it is assumed, that 5% per year refrigeration systems of newly registered road vehicles are filled using refrigerants with the lowest GWP (150 and less). The average lifetime of road vehicles is 16-19 years (depending on vehicle category).
- Stationary AC (2.F.1.f): a ban on the use of HFCs with GWP of more than 2500 in new stationary equipment since 2020.
- Foam blowing (2.F.2) and Fire extinguishers (2.F.3): projected emissions were based on existing measures (Regulation (EU) 517/2014 Annex V) and extrapolated until 2050.
- Metered Dose inhalers (2.F.4): it is assumed that HFCs emissions from metered dose inhalers will continue to increase; due to the F-gas regulation does not prohibit the use of HFCs for medical

[16] http://www.cementas.lt/index.php?id=137

devices. Regression analysis of historical data and population dependency was performed. In this context, the forecast for 2050 was set.

Non-energy products from fuels and solvent use

Consumption of lubricant oil and paraffin waxes for non-energy purposes is assumed to stay constant at the level of 2022 due to forecasts promise very little economic growth (Table 4-11).

Projections of solvent use are based on the population trends up to the year 2055 (Table 4-11). Emissions from Solvent use sector are projected to decrease a little due to projection of population show a decreasing trend.

Table 4-11. *Base year and projected parameters of non-energy products from fuels and solvent use (kt)*

Projected parameters	BY 2022	2025	2030	2035	2040	2045	2050	2055
Lubricant use	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Paraffin wax use	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41
Population in Lithuania, million	2,831	2,585	2,851	2,831	2,806	2,780	2,754	2,729

Metal Industry

The projections of CO_2 emissions from cast iron production were based on activity data provided by two companies (Table 4-12). According to companies' data it is assumed that cast iron production will start to increase until 2040 and will remain stable until 2055.

Table 4-12. *Base year and projected volume of metal industry (kt)*

Planned production	BY 2022	2025	2030	2035	2040	2045	2050	2055
Cast iron production	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

Electronics industry

Emissions from Electronic industry were calculated applying the 2006 IPCC Guidelines Tier 3 method using plant specific emission factors. Projected consumption of the SF_6 gases were based on the historical data and projected amount of SF_6 gases consumption are presented in the table below.

Table 4-13. *Projected amount of SF_6 gases consumption of electronics industry (t)*

Planned use of gases	BY 2022	2025	2030	2035	2040	2045	2050	2055
SF_6	0.320	0.320	0.320	0.320	0.320	0.320	0.320	0.320

Other product manufacture and use

Emissions from 2.G.1 and 2.G.2 subcategories are calculated applying the 2006 IPCC Guidelines Tier 3 method using country specific emission factors. Consumption of the SF_6 gases in electrical equipment and accelerators is projected based on historical data and projected amount of SF_6 gases consumption are presented in the table below (Table 4-14).

Table 4-14. *Projected amount of SF_6 gases consumption of electrical equipment and other product manufacture and use (t)*

Planned use of gases	BY 2022	2025	2030	2035	2040	2045	2050	2055
SF_6	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026

Other

CO_2 emissions from carbonates use in flue gas desulphurisation (2.H.3) were calculated using 2006 IPCC Guidelines Tier 1 method based on mass of carbonates used. Activity data (limestone use) was supplied by power plant. The company has reported that limestone use has not been foreseen since 2022, so emissions will not occur after 2021.

4.3.2.2. Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation of the Republic of Lithuania and Ministry of Environment of Republic of Lithuania, the implementation period of measures will cover period of 2021–2030. For the period of 2031–2055 all additional measures will continue to be implemented at the same rate as it is expected in 2030.

The planned PaMs in industrial sector are focusing on implementation and promotion of technological eco-innovation and modern technologies, support (partial financing) of replacement of pollutant technologies with greener technologies, promoting traditional industrial transformation and reduction of F-gases use in business companies. Financial support for companies acquiring new or replacing existing equipment with equipment using other technological alternatives (refrigerants with lower GWP) will reduce the amount of F-gases used to refill old equipment or to fill the new equipment for the first time and the refrigerants with lower GWP will be used, leading to reduction in GHG emissions.

List of PaMs and cumulative GHG reduction effect for 2021–2030 is provided in Chapter 2.4.3.

4.3.3. Projections of GHG emissions

4.3.3.1. Scenario "with existing measures" (WEM)

GHG emissions projections for IPPU sector are presented in the table below. The largest source of GHG emissions is chemical industry emissions. Regarding the share of GHG emissions it will not change a lot during projected period and chemical industry category will remain the largest source of emissions in industrial processes and product use sector. As it was anticipated that economic recovery started from 2010, and the industrial production increased. The GHG emissions in industry sector are determined by technology processes and integration of electrolysis into the ammonia unit will achieve a significant reduction of 27% in CO_2 emissions until 2030. It is expected that GHG emissions from 2020 will decrease because of restrictions of Regulation (EU) No 517/2014 and decreasing effect on emissions from uses of F-gases. Compared to 2022 emissions from IPPU sector are expected to decrease by 34% in 2030, by 76% in 2040 and by 91% in 2055.

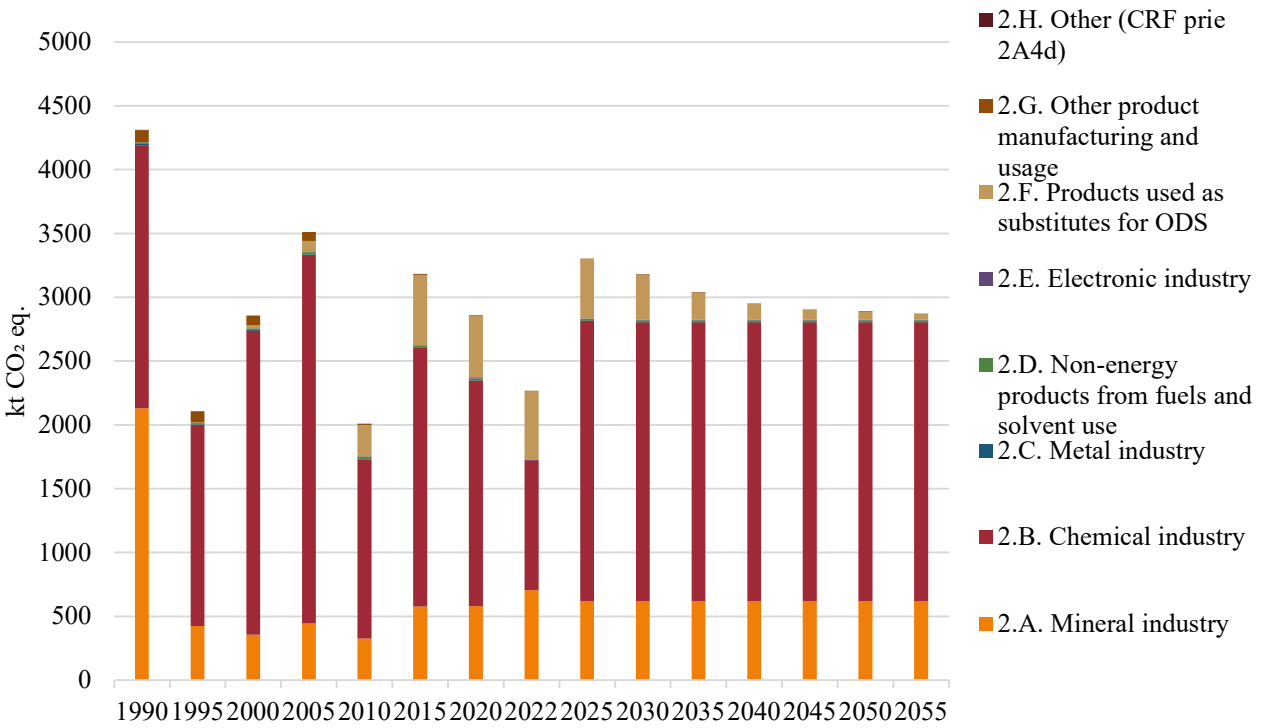

Figure 4-15. Total historical and projected GHG emissions from IPPU sector in 1990–2055, kt CO_2 eq.

Table 4-15. *The total emissions in IPPU sector in case of WEM scenario, kt CO_2 eq.*

IPPU categories	BY 2022	2025	2030	2035	2040	2045	2050	2055
2.A Mineral Industry	703.4	616.0	616.3	616.6	616.9	616.9	616.9	616.9
2.B Chemical Industry	2,200	2,188	2,188	2,188	2,188	2,188	2,188	2,200
2.C Metal Industry	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
2.D Non-energy products from fuels and solvent use	15.23	15.22	15.22	15.22	15.22	15.22	15.22	15.22
2.E Electronics Industry	3.76	3.76	3.76	3.76	3.76	3.76	3.76	3.76
2.F Product uses as substitutes for ozone depleting substances	535.9	465.2	352.1	212.2	124.7	77.2	63.6	44.9
2.G Other product manufacture and use	4.04	3.80	3.80	3.80	3.80	3.80	3.80	3.80
2.H Other	NO	NO	NO	NO	NO	NO	NO	NO
Total GHG emissions	2,282	3,304	3,179	3,039	2,953	2,905	2,891	2,873

Chemical Industry

The main GHG emissions source in IPPU sector remains nitric acid and ammonia production (Figure 4-13, Table 4-15). The company plans to phase I of the integration of electrolysis into the ammonia unit so that 30% of green hydrogen is fed to this ammonia unit. It is projected that GHG emissions from chemical industry will decrease by 10% in 2055 compared with 2022.

Mineral Industry

As volume of mineral industry is expected to increase for the projected period, the GHG emissions will decrease accordingly by approximately 14% in 2040 compared with 2022. It is assumed that emissions after 2040 will remain stable until 2055.

Product uses as substitutes for ozone depleting substances (ODS)

The projections of F-gases emissions for most sub-categories were based on 1995–2022 emissions trend by including relevant technological improvements and considering the impacts of the F-gases Regulation (EU) No 517/2014 implementation (introduced restrictions/controls of the use and introduction of quotas for placing on the market of HFCs). Projected emissions from the consumption of HFCs in 2022–2055 are presented in the table below.

Table 4-16. *Projected emissions from consumption of HFCs in 2022–2055, kt CO_2 eq.*

Product uses as substitutes for ODS category	BY 2022	2025	2030	2035	2040	2045	2050	2055
Total GHG emissions	535.9	465.2	436.7	420.3	399.1	368.4	352.1	341.5

It should be noted that restrictions due to Regulation (EU) No 517/2014 have a decreasing effect on emissions. Emissions from domestic refrigeration equipment are expected to decline due to EU wide measures and technical changes resulting in decreased leakage. One can assume that due to the ban on HFCs in new domestic refrigerators and freezers since 2015 only emissions from existing stocks and disposal will occur. It is expected that emissions from commercial and industrial refrigeration sectors will decline in 2020–2050. The projected decline in 2020 is expected due to the entering into force of the new prohibition on the use of HFCs with GWP of 2,500 and more to service or maintain refrigeration equipment. According to GHG inventory data, currently in Lithuania commercial and industrial refrigeration equipment contains HFC-32, HFC-125, HFC-143a and HFC-134a gases. Due to HFC-125 and HFC-143a gases GWP is higher than 2,500, the use of these gases to service and maintain refrigeration equipment will be prohibited from 2020. Furthermore, refrigerators and freezers for commercial use that contain HFCs with GWP of more than 150 will be prohibited to place on the market from 2022 (HFC-32, HFC-134a). Implementation of F-gases quota system will reduce amount of HFCs placed on the market by 79% between 2015 and 2030. Considering that the lifetime of the equipment/cars and road vehicles is 15-24 years, most of the emissions in 2030-2040 from disposal will occur. Considering these assumptions, it is predicted that in 2050 emissions from commercial and industrial refrigeration sectors will account only 20% compared to F-gases emissions in these sectors in 2019 (45%). The emissions from mobile air-conditioning will decrease also taking into account implementation of EU MAC Directive, which prohibits the use of F-gases with GWP of more than 150 in new types of cars and vans introduced from 2011, and in all new cars and vans produced from 2017. Emissions from Transport Refrigeration account for up to 20% of the total Lithuanian F-gas emissions in 2020 and are predicted to decrease in the upcoming years due to impact of the HFC phase down which is a key feature of Regulation (EU) No 517/2014. The phase down will reduce the quantity of HFCs that can be sold in the EU. In addition to these emissions from foam blowing are expected to decrease due to restrictions of Regulation (EU) No 517/2014. Despite this, it is assumed that emissions from metered dose inhalers will continue to increase due to the F-gas regulation does not prohibit the use of HFCs for medical devices.

Non-energy products from fuels and solvent use

Emissions of non-energy products from fuels and solvent use will decrease mainly due to decreasing trend of population. Comparing with 2022 CO_2 emissions from non-energy products from fuels and solvent use category will decrease by 2055.

Metal Industry

It is assumed that GHG emissions from metal industry will grow together with increasing cast iron production.

Electronics industry

The projected consumption of NF_3 and SF_6 gases were based on activity data provided by companies. It is assumed that emissions after 2025 will remain stable until 2055 (Table 4-17).

Table 4-17. *Projected emissions from consumption of NF_3 and SF_6 gases in Electronics industry (CRF 2.E.), kt CO_2 eq.*

Electronics industry category	BY 2022	2025	2030	2035	2040	2045	2050	2055
Total GHG emissions	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8

Other product manufacture and use

Assumptions on the projected amounts of consumption of the SF_6 gases in electrical equipment and accelerators and N_2O from product uses are based on historical data and projected emissions are presented in the table below.

Table 4-18. *Projected SF_6 emissions from Electrical equipment (CRF 2.G.1), Other non-specified (CRF 2.G.2) and N_2O from product uses (CRF 2.G.3), kt CO_2 eq.*

Other product manufacture and use subcategories	BY 2022	2025	2030	2035	2040	2045	2050	2055
2.G.1 Electrical equipment and 2.G.2 Other non-specified	0.9	0.5	0.7	0.8	1.0	1.1	1.2	0.8
2.G.3 N_2O from product uses	3.1	3.3	3.1	3.0	2.8	2.7	2.6	3.0
Total GHG emissions	4.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8

Consumption of the SF_6 gases in electrical equipment and accelerators is projected to be equal to the 2022 level, and emissions until 2055 will remain stable, while emissions of N_2O from product uses will gradually decline due to decrease of the population during the projection period.

4.3.3.2. Scenario “with additional measures” (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of the Economy and Innovation of the Republic of Lithuania and Ministry of Environment of Republic of Lithuania, the implementation period of measures will cover period of 2021-2030. For the period of 2031-2055 all additional measures will continue to be implemented at the same rate as it is expected in 2030. The planned policies and measures in industrial sector are focusing on implementation and promotion of technological eco-innovation and modern technologies, support (partial financing) of replacement of pollutant technologies with greener technologies, promoting traditional industrial transformation and reduction of F-gases use in business companies.

The emissions from IPPU sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-19. *Projected GHG emissions in case of WEM and WAM scenarios (kt CO_2 eq.)*

	2025	2030	2035	2040	2045	2050	2055
WEM scenario	2,282	3,304	3,179	3,040	2,952	2,905	2,891
WAM scenario	2,282	3,304	3,179	3,040	2,952	2,905	2,891
Difference	0	0	0	0	0	0	0

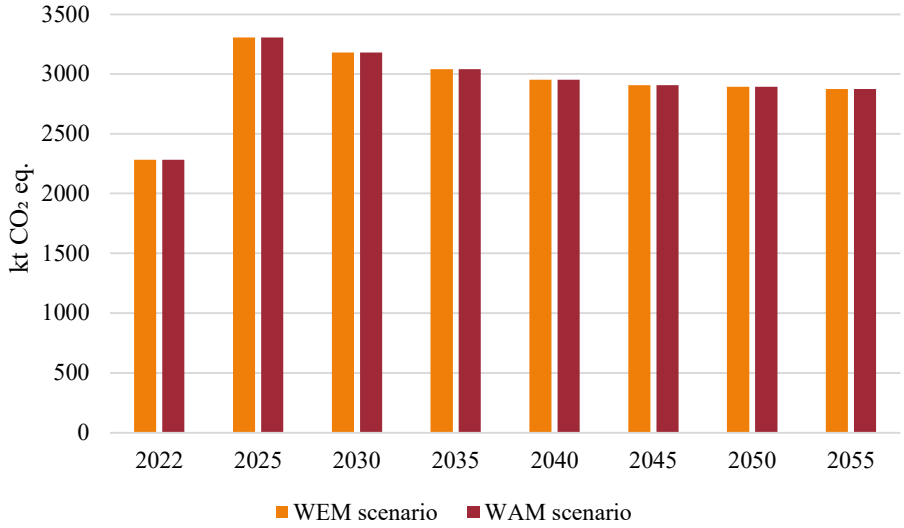

Figure 4-16. Projections of the WEM and WAM scenarios in IPPU sector

4.4. Agriculture

4.4.1. Overview of the agriculture sector

GHG emissions from the agriculture sector in Lithuania include: methane (CH_4) emissions from enteric fermentation of domestic livestock; CH_4 and nitrous oxide (N_2O) (direct and indirect) emissions from manure management; direct and indirect N_2O emissions from managed agricultural soils; carbon dioxide (CO_2) emissions from soil liming and application of urea. Direct N_2O emissions from agricultural soils include emissions that occur from application of inorganic nitrogen (N) containing fertilizers, application of organic fertilizers (manure, sewage sludge and compost), N deposited on pasture, range and paddock soils by grazing animals, nitrogen that is returned to soil with crop residues, N mineralized from loss in soil organic C, and cultivation of organic soils. Indirect N_2O emission sources include emissions from nitrogen atmospheric deposition and from nitrogen leaching and run-off, which are closely related to circumstances that influences direct N_2O emissions.

In 2022 total GHG emissions in agriculture sector contributed 4,059 kt CO_2 eq. which is 21.5% of the total GHG emissions in 2022 (excl. LULUCF). Agriculture sector is the major source of CH_4 and N_2O emissions. CH_4 emissions constituted almost 50% of the total CH_4 emissions in 2022 from agriculture, major part of it is occurring from enteric fermentation. Agriculture sector N_2O emissions contributed 48% in 2022, the major portion of N_2O emissions resulted from agricultural soils subcategory. The rest of N_2O emissions resulted from manure management (3.9%). Agriculture sector also includes CO_2 emissions which take a small share from the total agricultural emissions – 2.4%.

These emissions occur during liming of soil (1.2%) and application or urea fertilizers (1.2%). The share of GHG emissions from agriculture sector by categories is presented in the figure below.

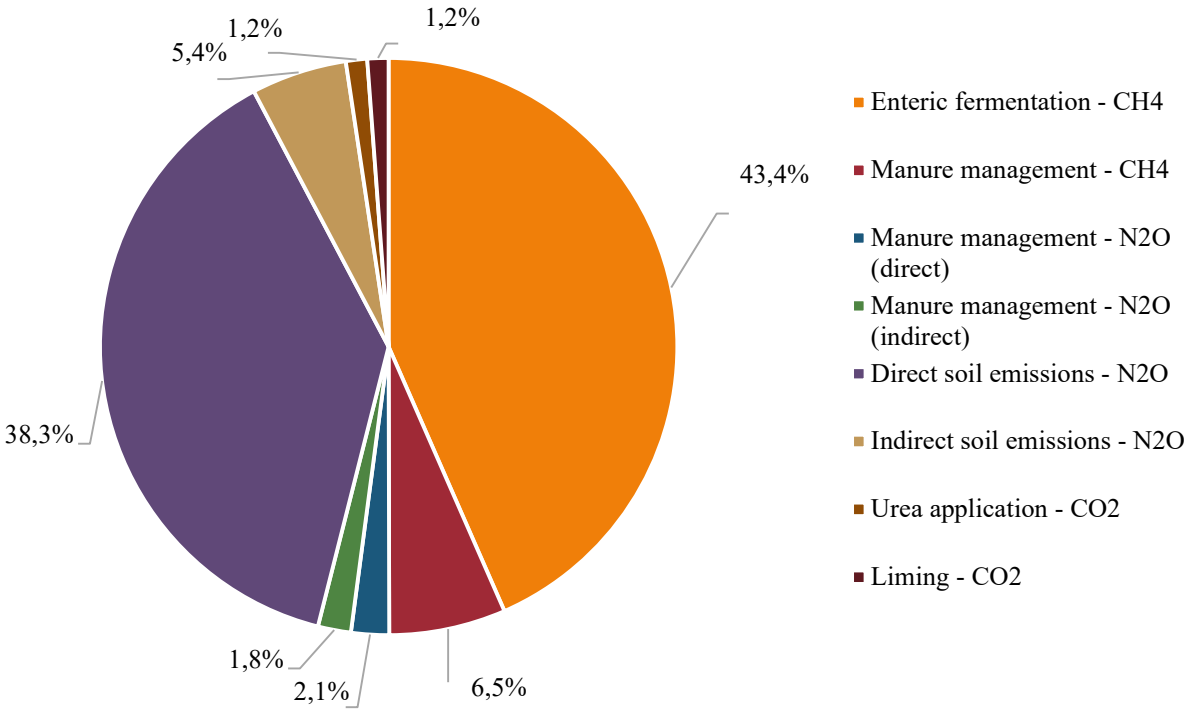

Figure 4-17. The share of GHG emissions by categories in the agriculture sector in 2022, %

In 2022 the total GHG emissions in the agriculture sector have decreased by 55% comparing with the 1990.

4.4.2. Methodology and key assumptions

Projections of GHG emissions from the agriculture sector with existing (WEM) measures are based on projected livestock population, milk production, milk fat, and the share of manure management systems for the main livestock categories (dairy cattle, non-dairy cattle and swine). GHG projections of agricultural soils category are based on projected consumption of inorganic and organic N fertilizers, main harvested crops and area harvested, application of urea and consumption of liming materials (limestone and dolomite) used for soils. Projections of the data mentioned above are provided by the Ministry of Agriculture (MoA). Scenario with additional measures (WAM) is based on additional measures provided by the MoA.

All projected data were available for the years of 2025, 2030, 2040, 2050 and 2055. The data in between were interpolated. The base year for the GHG agriculture projections is 2022.

Summary table of assessed emissions from the agriculture sector, methods applied, and emission factors are provided in the table below.

Table 4-20. *Methods and emissions factors used to estimate emission from the agriculture sector*

CRF	Source	Emissions reported	Methods	Emission factor
3.A	Enteric fermentation	CH_4	T1, T2	CS, D
3.B	Manure management	CH_4, N_2O	T1, T2	CS, D
3.D	Agricultural soils	N_2O	T1, T2	D
3.G	Liming application	CO_2	T1	D
3.H	Urea application	CO_2	T1	D

4.4.2.1. Scenario “with existing measures” (WEM)

Activity data projections

The changes of the livestock population over the projected period have been projected considering historical fluctuations in livestock numbers, livestock productivity, prevailing market prices, demand and exports, and the legislation adopted. The amount of inorganic and organic (compost and sewage sludge) N fertilisers consumption and soil liming materials have been projected considering the changes in the crop area. The demand for mineral N fertilisers will decrease with the expansion of the use of environment friendly technologies. Crop yield projections have been made considering crop and soil fertility, projected crop area and the cropping technologies promoted. Crop area projections are based on historical data, the world market situation and the development of agro-biotechnologies. Crop yields are projected to increase, and wheat, barley and oilseed rape are expected to remain the main crops grown.

Overall, livestock populations are projected to decrease by 18% in 2030 compared to 2022. It is projected that the largest declines will be in dairy cattle (17%), poultry (11%) and fur-bearing animals (95%) populations. A slight increase in livestock population is projected in 2040 (1%) compared to 2030, with growth in goats (3%), poultry (2%) and horses (1%). However, cattle and swine populations will continue to decline. Consumption of inorganic nitrogen (N) fertiliser is projected to increase by 28% by 2030 compared to 2022. This expected rise follows a significant decline in 2022, driven by the energy crisis. After 2023, fertiliser consumption is anticipated to return to pre-crisis levels. However, beyond 2030, a gradual decrease is expected, with consumption projected to decline by 6% by 2040 and continue a downward trend until 2050. This reduction will be driven by policy measures promoting more sustainable agricultural practices, such as organic farming and crop rotation. The use of organic N fertilisers will also decrease due to the declining population of livestock. In general, it is projected that crop yields should remain stable by 2030, and harvested area could decrease by 3% compared to 2022. The use of rotations of 5 or more crops will encourage the reduction of wheat areas and the introduction of a wider range of crops for both food production and the technical industry, resulting in higher yields of other cereal crops: rape (8%), triticale (19%) and oats (5%). Due to the projected decline in arable land, grassland will increase (5%) by 2030, also because of the promotion of the restoration of eroded land and the application of organic soil protection measures.

The assumptions to the assessment of existing PaMs: for measure A1-E “Climate-friendly livestock farming (manure management)”, the assessment of biogas production was carried out considering the capacity of the planned biogas plants and the estimated amount of manure that could be used. A1-E “Climate-friendly livestock farming (manure management)” measure acidification of slurry and slurry application has been evaluated considering the amount of manure that may be affected by the measures. A5-E “Promotion of short supply chains” will not have direct impact but would strengthen the development of organic farming. However, the effect of measure A5-E that relates to fuel use was assessed in the transport sector. Measures A3-E “Development of precision fertilisation”, A6-E “Development of protein crops”, A7-E “Development of no-till technologies, especially direct seeding”, A21-E “Balanced fertiliser system”, L5-E “Promotion of crop rotation”, and L4-E “Promotion of cover-crops” will all have an impact on the reduction of the consumption of inorganic N fertilisers. The assessment of these measures has been carried out considering the potential share of the reduction in inorganic N fertiliser consumption as presented in the consultation with scientists, as well as the area and/or number of farms affected by the measure. The impacts of measures A14-E “Reducing the use of fossil fuel” and A15-E “Revision of technology cards” were assessed in the

energy sector. The mitigation effect of GHG emissions of existing PaMs were estimated by applying the above-described assumptions and estimated according to the 2006 IPCC Guidelines.

4.4.2.2. Scenario "with additional measures" (WAM)

The focus in the agriculture sector is on the more effective and precise use of inorganic N fertilizers and the education of farmers. Also, the growth of the agriculture sector is based on technologies that are territorially and environmentally balanced, climate-friendly, resilient, competitive and innovative. Sustainable farming, keeping organic farming areas, rational use of inorganic N fertilizers, and their replacement with organic N fertilizers, promoting use of biogas plants are the most important measures in reducing GHG emissions.

The list of additional measures used to evaluate GHG emissions projection according to WAM scenario are provided in the Chapter 2.4.4 Agriculture in the Table 2-10.

All additional measures were provided by the MoA. As the major share of GHG emissions from agriculture sector comprise from agriculture soils most of the additional measures focus on more effective use of fertilizers and application of environmentally friendly technologies.

The assumptions to the assessment of planned policies and measures: for measure A1-P "Climate-friendly livestock farming (manure management)", the assessment of biogas production was carried out considering the capacity of the planned biogas plants and the estimated amount of manure that could be used. A1-P "Climate-friendly livestock farming (manure management)" measure acidification of slurry and slurry application has been evaluated considering the amount of manure that may be affected by the measures. Measures A3-P "Development of precision fertilisation" and A19-P "Sustainable use of public land" will all have an impact on the reduction of the consumption of inorganic N fertilisers. The assessment of these measures has been carried out considering the potential share of the reduction in inorganic N fertiliser consumption as presented in the consultation with scientists, as well as the area and/or number of farms affected by the measure. For measure A20-P "GHG accounting on farms", the assumption of the proportion of farms affected was used to estimate the measure. The mitigation effect of GHG emissions of existing PaMs were estimated by applying the above-described assumptions and estimated according to the 2006 IPCC Guidelines.

4.4.3. Projections of GHG Emissions

4.4.3.1. Scenario "with existing measures" (WEM)

The emissions from agriculture sector for WEM and WAM scenarios are provided in the table and figure below.

Table 4-21. *Projected GHG emissions in case of WEM and WAM scenarios, kt CO_2 eq.*

	2022	2025	2030	2035	2040	2045	2050	2055
WEM scenario	4,059	4,124	3,815	3,776	3,705	3,666	3,625	3,625
WAM scenario	4,059	4,100	3,677	3,609	3,527	3,478	3,440	3,440
Difference (WEM-WAM), kt CO_2 eq.	0	24	138	167	177	188	185	185
Difference (WEM/WAM), %	0%	1%	4%	5%	5%	5%	5%	5%

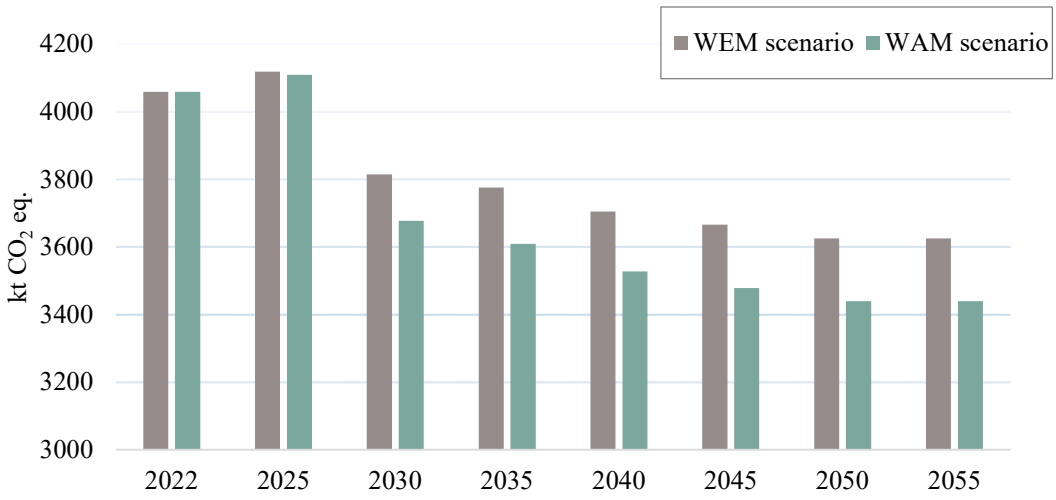

Figure 4-18. Projection of the WEM and WAM scenarios in agriculture sector

Scenario "with existing measures" (WEM)

GHG emissions projections for the agriculture sector are provided for five subsectors: enteric fermentation, manure management, agricultural soils and CO_2 emissions from liming and urea. The table below presents aggregated GHG emissions from the agriculture sector. The largest source of GHG emissions is agricultural soils, particularly direct soils emissions. The share of GHG emissions will not change a lot during projected period, agricultural soils subsector will remain the largest source of emissions in agriculture sector. Compared to 2022 emissions from agriculture sector will decrease by 6% in 2030, by 9% in 2040 and 11% in 2055.

Table 4-22. *Projected GHG emissions from agriculture sector by category in case of WEM scenario, kt CO_2 eq.*

Agriculture sector categories	**2022**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**
Enteric fermentation	1,763	1,706	1,588	1,573	1,556	1,556	1,556	1,556
Manure management	419	358	253	245	236	231	219	219
Agriculture soils	1,773	1,984	1,898	1,883	1,839	1,808	1,781	1,781
Urea application	48	23	23	23	23	23	23	23
Liming	48	52	53	52	51	48	45	45
Total GHG emissions	**4,058**	**4,124**	**3,815**	**3,776**	**3,705**	**3,666**	**3,625**	**3,625**

The figure below represents GHG emissions trend during the historical and projected period.

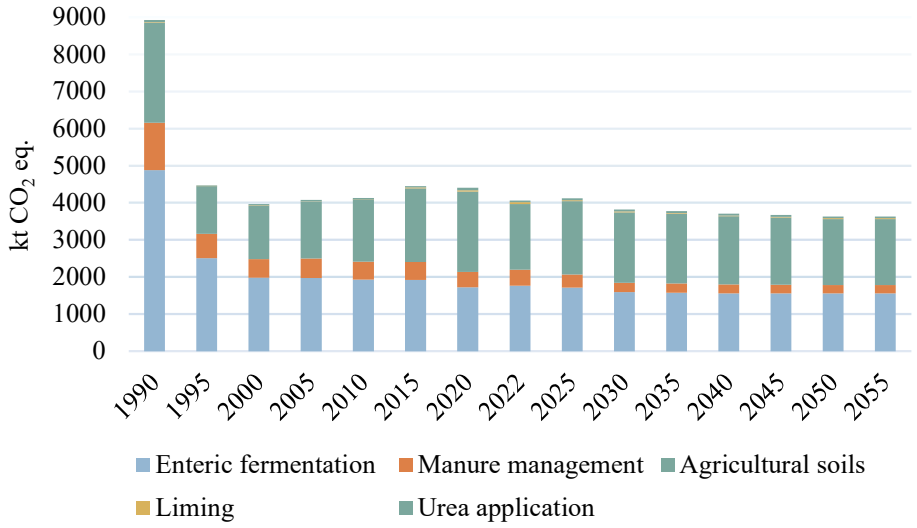

Figure 4-19. Historical and projected GHG emissions from the agriculture sector by category under WEM scenario

Compared to 2022, GHG emissions from agriculture are projected to decrease by 6% by 2030 and by 3% in 2040 (compared to 2030) and by 2% in 2055 (compared to 2040). The largest GHG reductions in livestock production will be seen in the manure management category in 2030. This decrease is attributed to the impact of measure A1-E "Climate-friendly livestock production (manure management)", the implementation of the development of biogas plants. GHG emissions from enteric fermentation will decrease by 10% in 2030 compared to 2022, partly due to the decrease in the livestock population. GHG emissions from enteric fermentation are projected to decrease by a further 2% by 2040. GHG emissions from agricultural soil are projected to increase by 7% in 2030 compared to 2022. This growth is attributed to the energy crisis, which led to a surge in inorganic N fertilizer prices, resulting in reduced fertilizer use and, consequently, lower GHG emissions. However, inorganic N fertilizer consumption is expected to return to pre-crisis levels in 2024, and from 2025 onwards, emissions are anticipated to decline due to the implementation of GHG reduction measures. From 2030 GHG emissions from agricultural soils will decrease by a further 6% by 2055.

4.4.3.2. Scenario "with additional measures" (WAM)

The WAM scenario is based on the additional measures provided by the MoA, the implementation period of measures will cover the period of 2021–2030. For the period of 2031–2055 additional measures will continue to be implemented at the same rate as it is expected in 2030. Most of these measures focus on more sustainable use of inorganic N fertilizers and application of environmentally friendly technologies.

List of policies and measures and cumulative GHG reduction effect for 2021–2030 is provided in Chapter 2.4.4.

The emissions from agriculture sector WAM scenario and GHG emissions reduction are provided in the table and figure below.

Table 4-23. *Projected GHG emissions from the agriculture sector according to WAM scenario, kt CO_2 eq.*

	2022	2025	2030	2035	2040	2045	2050	2055
Enteric fermentation	1,763	1,706	1,585	1,568	1,552	1,552	1,552	1,552
Manure management	419	335	134	112	93	77	68	68
Agricultural soils	1,773	1,984	1,882	1,854	1,809	1,779	1,752	1,752
Liming	48	23	23	23	23	23	23	23
Urea application	48	52	53	52	51	48	45	45
Total GHG emissions	**4,058**	**4,100**	**3,677**	**3,609**	**3,527**	**3,478**	**3,440**	**3,440**

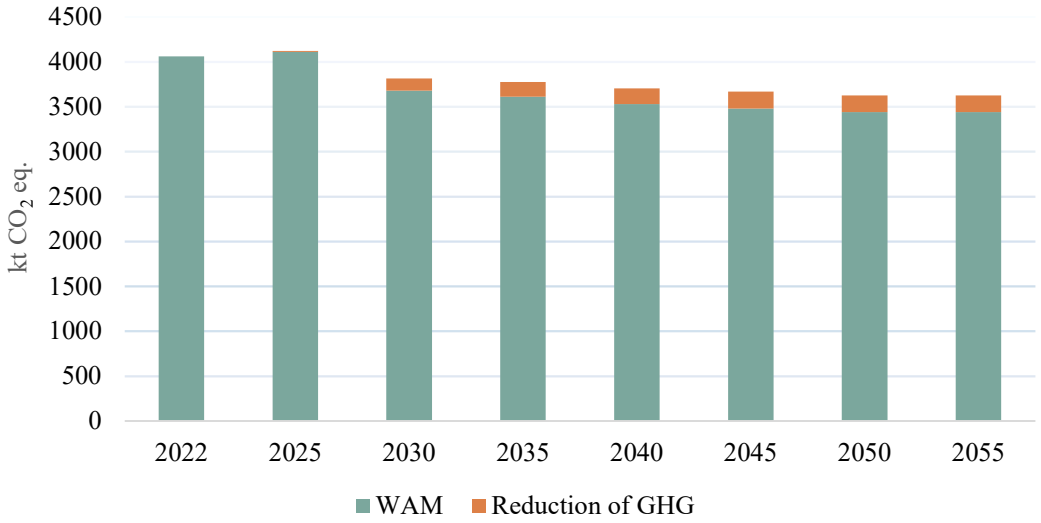

Figure 4-20. Projected emissions of agriculture sector under WAM scenario

Compared to 2022, the planned additional measures are projected to reduce total GHG emissions from agriculture by 9% in 2030, by 4% in 2040 (compared to 2030) and by 2% in 2055 (compared to 2040). The planned policy measures are projected to result in the largest GHG reductions in the manure management category, with the continued development of the planned measure A1-P "Climate-friendly livestock farming (manure management)". By 2055, GHG emissions in agriculture soil category will be reduced by 7% compared to 2030. The decrease is attributed to a reduction in the consumption of inorganic N fertilisers through the promotion of precision fertiliser technology, the promotion of more sustainable manure management techniques (slurry acidification, direct incorporation) and other planned policy measures.

4.5. Land use, land use change and forestry

4.5.1. Overview of the LULUCF sector

In general, historical GHG emissions from sources and removals in sinks in LULUCF sector in Lithuania are mostly related to three main categories – forest land, cropland and grassland, with addition to wetlands if there are significant amounts of peat extracted in peat extraction areas or conversions to flooded land. Historical land use patterns, usually determined by economic and political situation play a key role in land use changes and emissions or removals afterwards.

Perfunctory forest land accounting during inter-war and later occupation period as well as introduction of various support schemes for agricultural land, afforestation/reforestation (especially after Lithuania joined the EU and Common Agricultural Policy have launched) has led to rather considerable land use changes and different land management, which in the end has caused fluctuations in total emissions and removals trend. Emissions and removals in LULUCF sector in Lithuanian fluctuate not only due to the land use changes, but also environmental impacts – for example in 1996 and 1997 after the long-lasting droughts and subsequent pest invasions forest land category resulted not only in decreased GHG sink but also became a source of GHG emissions for the short time period. Slightly decreasing living biomass carbon stock changes in forest land in the recent years are also related to reduce growing stock volume increment, which is not only limited by the aging forests but also strongly affected by natural conditions.

Forest land

Forest coverage in Lithuania was expanding continuously since 1948, however, data on forest coverage in Lithuania during inter-war period is very limited and the exact numbers are still unknown. Expert judgement made by the authors of "The Chronicle of Lithuanian Forests. XX Century" allows us to presume forest coverage to be around 21% in 1938; even though some authors argue that only small part of heavily afforested areas of Vilnius region (south-eastern part of Lithuania) were included into this number at that time, and some 150 thous. ha could be unaccounted. The lowest forest coverage has been accounted during the World War II and through occupation period, because no forest preservation policy existed at that time. During the period when Lithuania was part of Soviet Union, forest accounting was rather thorough – unfortunately only in State owned forests. Forests belonging to collective farms and being less than 10 ha were disregarded as well as those belonging to small farms and being less than 1 ha. After restoration of Independence in 1991, there were no legal obstacles for implementation of forest accounting. However, the land reform has been also started at that time, so the State Forest Inventory (SFI) has been suspended or even discontinued as less important. In 1996, when the new cycle of SFI has been started there were found numerous areas of naturally afforested areas that were missing in the previous inventories or in State land accounting related documents. After Lithuania joined the EU and Common Agricultural Policy has started, annual afforestation and reforestation areas started to increase, but the most significant increase has been estimated from 2010 and for the last 10 years fluctuated between 2.4 to 6.8 thous. ha annually. In addition to this, highest removals in forest land were estimated at the same period from 1997, reaching up to -10,182 kt of CO_2 eq. per year in 2011. However, NFI measurements show a decreasing trend of growing stock volume change in the latest years, which may be caused due to aging forest stands and thus decreasing growing stock increment and GHG removals in forest land decreased to -6461.6 kt CO_2 eq. in 2022.

Agricultural land (cropland and grassland)

There were significant changes between cropland and grassland area during the reporting period since 1990. Early 90's had introduced significant reforms in agriculture sector as well as in others after Lithuania gained Independence from Soviet Union and planned economy had to be switched to the market economy. The main target was re-establishment of private ownership and management. Even though legal acts were adopted for dismemberment of the collective farms, but they did not ensure their replacement by at least equally productive private farms or corporations and as a result agricultural production decreased by more than 50% from 1989 to 1994. The farms were broken into small holdings, averaging 8.8 ha in size, often not large enough to be economically viable. Area of grasslands prevailed and started to increase afterwards substituting the area of abandoned cropland.

Cropland and grassland areas have changed dramatically in Lithuania since 2005 as a result of introduced Single Area Payment Scheme (SAPS), starting in 2004. SAPS is a form of support whereby direct payment is made for agricultural land irrespective to the type of production carried out on the land, and this might be one of the reasons of decrease in grasslands area. Furthermore, in 2004 when Lithuania became the member of EU, communities Structural Funds became available. In order to use funding from EU Structural Funds efficiently, the Single Programming Document (SPD) of Lithuania for 2004-2006 was prepared. The strategy provided in the SPD was divided into priorities and implemented on the basis of one or several measures. During 2004–2006, 191 million EUR was allocated to implement the measures of the Rural and Fisheries Development priority. According to the support contracts signed, the largest amount of funding (95 million EUR) was allocated to beneficiaries who submitted applications for the measure named "Investments into Agricultural Holdings". These measures resulted in agricultural land management, hence increase in croplands area and decrease in grasslands that were ploughed for agricultural purposes. Areas of cropland continued to increase resulting in decreasing grassland areas until 2022.

Wetlands

The total CO_2 emissions from wetlands have been ranging since 1990. Even though the area of wetlands was slightly decreasing till 2021, there was the tendency of increasing CO_2 emissions. The CO_2 emissions in wetlands were 860.2 kt CO_2 eq. in 2022; the highest emissions from this category were reported in 2015 and reached 964.5kt CO_2 (due to forest land conversion to wetlands). The largest emissions from wetlands category originate from wetlands remaining wetlands – peat extraction areas (in 2022 emissions were 856.2 kt CO_2). Emissions from conversion of grassland, cropland and forest land to flooded land were not assessed annually and were minor compared to the total emissions.

Settlements

The area of settlements in Lithuania has been increasing with low extent. In 1990 the land of settlements category had occupied 347 kha of country land, thus, till 2022 area of settlements increased by 38.3 kha. However, if to compare the intensity of area conversion to settlements, it was certain that area where settlements remained settlements was not changing distinctly and occupied on the average of 339 kha. The increase in the area of land converted to settlements was evident. In 1991 the area of land converted to settlements was 0.4 kha, thus, in 2022 distribution of area reached 39.5 kha (cumulative area of 20 years conversion period). Emissions from settlements category has an increasing trend due to the increasing conversions: total GHG emissions from settlements were 5.5 kt CO_2 eq. in 1990 and reached 548.3 kt CO_2 eq. in 2022.

Other Land

This category is included for overall land area consistency checking. All land not classified as *Forest land, Croplands, Grasslands, Wetlands and Settlements* were defined as *Other land* and reported together as a separate category in the CRF Reporter. Conversions to other land from forest land, cropland and grassland to other land occurred as after the quarries (sand, gravel, etc.) have been established in previous land use categories.

The total CO_2 emissions from other land have been ranging in not a high scope but one CO_2 emissions increase peak were denoted in 2018, where CO_2 emissions have reached 507 kt CO_2 eq. Despite the peak, CO_2 emitted from other land area was ranging from 26.2 kt CO_2 eq. (in 1992) to 195.7 kt CO_2 eq. (in 1994). Intense CO_2 emissions at peak event could be explained by high emissions from loss

of living biomass in deforested area and intensive mineralization of forest soil organic matter, resulting in significant decrease of organic carbon in relevant carbon stocks.

Harvested wood products

According to the estimates of Lithuania's National GHG Inventory Document, harvested wood products pool has been acting as a CO_2 sink in the entire reporting period from 1990 to 2022, reaching the highest amount of GHG removed in 2003: -1,547 ktCO_2 eq. Note that annual carbon balance of HWP's varies substantially, depending on the economic situation and market demand and in 2022 it reached 1,467.4 kt CO_2 eq.

Historical emission trends

Historical emission trends are provided using inventory data reported in the National Inventory Document (NID), submitted in 2024 which comprise 1990–2022 accounting period. Past emission trends up to 2022 (base year is 2022) for all land use categories are provided in the picture below.

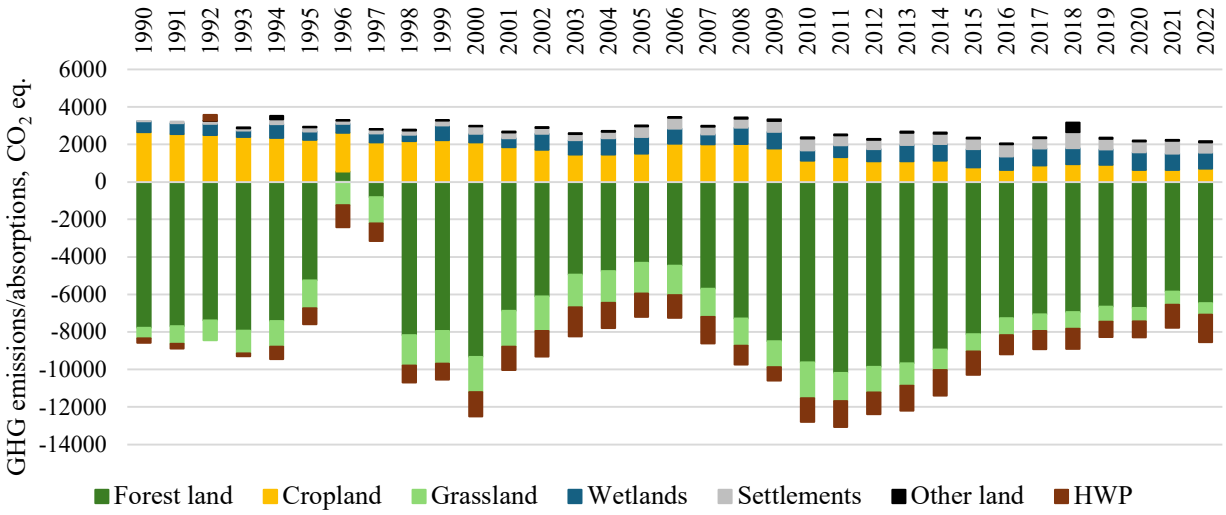

Figure 4-21. Total GHG emissions/removals from LULUCF sector for the period 1990–2022, kt CO_2 eq.

LULUCF sector for 1990–2022 as a whole acted as a net CO_2 sink except in 1996 when emission constituted to 883.65 kt CO_2 eq. (Figure 4-21). That is explained by sudden spruce dieback that caused huge losses in trees volume, in Lithuania`s spruce stands, which has direct impact on biomass calculations and on CO_2 balance from this sector. During the entire reporting period LULUCF sector have been able to remove around 29% of the total CO_2 emissions in Lithuania, the share fluctuating from 1% in 1997 to 50% in 2010 (Figure 4-22). Largely these removals should be contributed to forest land with the significant addition from grassland and harvested wood products in recent years.

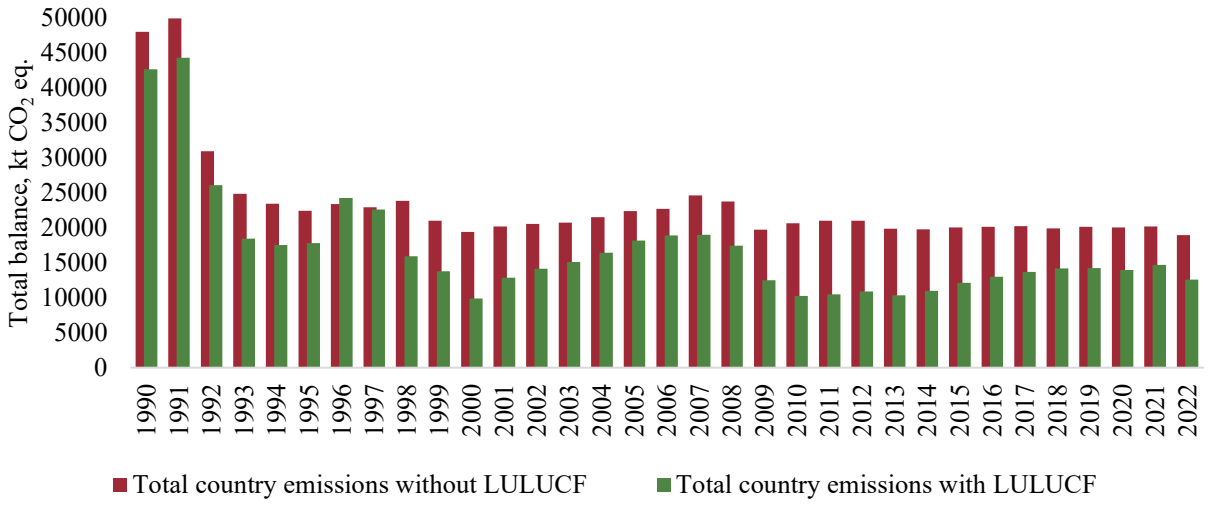

Figure 4-22. Total GHG emissions with and without LULUCF sector for the period 1990–2022, ktCO_2 eq.

4.5.2. Methodology and key assumptions

Methodology for estimation of projected GHG emissions and removals is the same as used for annual GHG inventory document submitted under UNFCCC. Short description of the methodology used for GHG projections estimation is provided in this chapter, detailed description of the methodology for GHG emissions and removals estimation in LULUCF sector is provided in National GHG Inventory document 2024, chapter 6.

The main data source for land use changes and growing stock volume changes in forest land is National forest inventory, started in 1998 on forest land and expanded to all land use since 2012. Therefore, implementing UNFCCC and its Kyoto Protocol requirements to comprehensively identify and quantify areas specific to LULUCF activities annually in the period of 1990–2011, two studies were launched. The study "*Forest land changes in Lithuania 1990-2011*" (*Study-1*) was addressed to recover land use changes specifically to forests and study "*Changes of areas of Croplands, Grasslands, Wetlands, Settlements and Other lands in Lithuania during 1990–2011*" (*Study-2*) was addressed to track changes of croplands, grasslands, wetlands, settlements and other lands. Thus, by implementing these studies Lithuania became able to identify land use areas and to monitor their changes for the whole time series starting with 1990. Therefore, one of the fundamental outcomes of these two studies was creation of a single and comprehensive database of land use areas in Lithuania.

Forest land

The GHG inventory for Forest land remaining forest land involves estimations of changes in carbon stock in five carbon pools (above-ground biomass, below-ground biomass, dead wood and litter, and soil organic matter) as well as estimations of non-CO_2 gases from those pools, using 2006 IPCC Guidelines. The algorithm for assessment of carbon stock changes in carbon pools is given below:

ΔC_{LUi} – carbon stock changes for a stratum of a land-use category;

ΔC_{AB} – annual change in carbon stock in above-ground biomass, t C yr^{-1};

ΔC_{BB} – annual change in carbon stock in below-ground biomass, t C yr^{-1};

ΔC_{DW} – annual change in carbon stock in deadwood, t C yr^{-1};

ΔC_{LI} – annual change in carbon stock in litter, t C yr^{-1};

ΔC_{SO} – annual change in carbon stock in soil, t C yr^{-1};

ΔC_{HWP} – annual change in carbon stock in harvested wood products, t C yr^{-1}.

ΔC_{AB}, ΔC_{BB} and ΔC_{DW} are calculated using NFI data on growing stock and dead wood volume changes, default basic wood density factors for coniferous and deciduous tree strands, country specific biomass expansion factors for coniferous and deciduous tree stands, default carbon fraction of dry matter.

ΔC_{LI} is calculated for land converted to forest land only, using area from NFI measurements and country specific carbon stock change factors. It is assumed that there are no carbon stock changes in litter in forest land remaining forest land.

ΔC_{SO} for mineral soils are calculated for land converted to forest land only, using area from NFI measurements and country specific carbon stock change factors in mineral soils. It is assumed that there are no carbon stock changes in mineral soils in forest land remaining forest land (as show the results from BioSoil project[1,11]). Carbon stock changes in organic soils are calculated as a consequence of drainage, where areas of drained organic soils are estimated using proportion of drained organic soils, established during 2nd NFI measurement cycle (2003–2007), and actual forest land remaining forest land and land converted to forest land areas with default emission factors for CO_2 and N_2O emissions.

ΔC_{HWP} is calculated using statistics of wood commodities (sawnwood, wood-based panels, paper and paper-board) as reported by FAO and calculation spreadsheets with default half-life values for each product group under IPCC 2006 Guidelines.

Additionally, to carbon stock changes reported in pools, GHG emissions from biomass burning are calculated as well. Data on areas affected by forest fires under the category Forest land remaining Forest land is provided by the Directorate General of State Forests as well as the proportion of biomass, litter and peat layer burnt in the event of fire. Default emission factors of CO_2, CH_4 and N_2O are applied from 2006 IPCC Guidelines.

Land converted to forest land

Data of areas of land converted to forest land are obtained from NFI measurements (natural forest expansion) and National Paying Agency (afforestation/reforestation under KP reporting). For the estimation of carbon stock changes in living biomass, growing stock volume of Lands converted to Forest land was estimated using data of *NFI* permanent sample plots on mean growing stock volume of non-forest Lands converted to Forest land according to the year of conversion. Growing stock volume estimation for new measured sample plots is executed using annual area of land converted to forest land, distributed according to the number of years after conversion, and modelled mean growing stock volume change for each of the abovementioned land converted to forest land group. 2nd order polynomial trend was used to come up with mean growing stock volume and mean growing stock volume increment of lands converted to Forest land. Basic wood density, biomass expansion factors and carbon fraction from dry biomass are applied as for forest land remaining forest land. It is assumed that dead wood is not present in newly afforested areas/natural forest expansion areas, therefore only carbon stock changes in litter and soils are estimated using country specific stock change factors. GHG emissions due to the drainage of organic soils are calculated as for forest land remaining forest land.

Cropland & Grassland

The GHG inventory for cropland and grassland involves estimations of changes in carbon stock in carbon pools: biomass and soil organic matter as well as estimations of non-CO_2 gases from those pools, using 2006 IPCC Guidelines.

Biomass carbon stock changes are calculated for cropland category in the subcategory of perennial cropland – commercial gardens with the default biomass growth and final biomass at the time of harvest values. Biomass carbon stock changes in land converted to cropland and land converted to grassland category are calculated due to the different maximum biomass accumulated in different land-use categories as provided in 2006 IPCC Guidelines. In addition to this, carbon stock changes in litter and dead wood in lands converted to and from grassland were included in the reporting for projections for the first time.

ΔC_{SO} for mineral soils are calculated for land converted to cropland or grassland only, using area from NFI measurements and country specific carbon stock change factors developed in mineral soils. Carbon stock changes in organic soils are calculated as a consequence of drainage, where areas of drained organic soils are estimated using proportion of drained organic soils, established during years 2014-2018 of NFI measurements, and actual cropland and grassland areas with default emission factors for CO_2 and N_2O emissions.

Additionally, to carbon stock changes reported in pools, GHG emissions from biomass burning are calculated as well. Data on areas affected by wildfires under the categories of cropland and grassland are provided by the Fire and Rescue Department under the Ministry of Internal Affairs. Default emission factors of CO_2, CH_4 and N_2O are applied from 2006 IPCC Guidelines.

Wetlands, Settlements & Other land

Calculations are done similarly to grassland category with corresponding default carbon stock change or emission factors from 2006 IPCC Guidelines. The exception is peat extraction remaining peat extraction subcategory, where GHG emissions are calculated both from the area of peat extraction sites (provided by Lithuanian Geological Survey) and amount of peat produced for horticultural uses (data provided by the Statistics Lithuania).

Summary table of reported emissions from sources and removals from sinks as well as methods and emission factors used is provided below.

Table 4-24. *Reported emissions/removals and calculation methods for LULUCF sector categories*

CRF category	Emission / removal reported	Methods used	Emission factor used
4.A Forest Land; 4.B Cropland; 4.C Grassland; 4.D Wetlands; 4.E Settlements; 4.F Other land			
Carbon stock change	CO_2	T1; T2	CS; D
4(II) Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2; N_2O	T1; T2	D
4(III) Direct N2O Emissions from N Mineralization/Immobilization	N_2O	T1: T2	CS; D
4(V) Biomass Burning	CO_2; N_2O	T1; T2	D
4.G Harvested wood products			
Sawnwood	CO_2	T1; T2	D
Wood panels	CO_2	T1; T2	D
Paper and Paperboard	CO_2	T1; T2	D

4.5.2.1. Scenario “with existing measures” (WEM)

Scenario with existing measures include measures already adopted and implemented. Currently there are 16 measures under WEM scenario. These measures will be described under relevant land uses while also mentioning what effects they are expected to have until 2055. Most of these measures are

planned only until 2030, however their effects will be calculated for at least 20-year period. The list of the measures that were applied for modelling these scenarios is taken from the National energy and climate plan (NECP). Compared to last report, quite a few measures moved from "additional" to "existing", that means, the gap between scenarios is very narrow.

Methodological assumptions

Forest land remaining forest land. The main carbon sink in the category is biomass, carbon stock changes are estimated from the growing stock volume changes estimated during NFI measurements and projected on the same basis regarding historical growing stock volume increment and forest use. The total volume of Lithuanian forests, the increase of the volume, the volume of felled and naturally dying trees are forecasted taking into account the change in growing stock volume increment inventoried by the NFI in 2002-2018 and its use. This data was used as a reference point for the estimation of total growth and its structure (main use, intermediate use, dead tree volume and volume change) in 2022-2055. The annual growing stock volume increment is slightly decreasing due to the ageing forests: from 20.03 in 2022 to 19.48 million m^3 per year in 2050. The decreasing growing stock volume increment is mainly related to changes in the structure of the tree age classes: recently, the middle-aged stands occupying the largest areas and generating the largest volume and carbon accumulation have been ageing, which leads to increasing areas of older and more mature stands with lower growing stock volume increment and GHG uptake. As some of the measures shifted from "additional" to "existing" there are some expected decreases in annual increment in forests due to forest reconstruction from low yielding tree species to high yield ones. The projected increase in the felled is related both to the increase in the volume felled during main felling in mature stands due to the projected increase in the area of mature trees and to the increase in the volume felled during intermediate felling, in particular thinning, in order to increase forest sustainability and reduce tree death and forest losses. The main use of forests was estimated taking into account the equivalent area of mature stands to be felled and the average volume of mature stands. An equivalent area of mature stands to be felled each year was calculated on the basis of the age class distribution of each tree species and the use of mature stands over a period of 12 to 15 years. In order to reduce natural mortality and consequently the forest cultivation losses, a gradual increase in the use of intermediate forests was forecasted. Intermediate forest use is projected to account for 40-50% of main forest use. In view of the increase of final and intermediate forest felling, total felled volume was projected to increase from 10.11 million m^3 in 2017 to 11.59 million m^3 in 2040. Thus, due to the projected increase in the volume of intermediate felling, smaller natural mortality (losses) of trees was projected. Volume accumulation in stand over the projection period is defined as the difference between the total growing stock volume increase and felled volume as well as natural mortality. The volume of felled trees and natural losses account for between 72% and 75% of the total annual increment in stand volume.

Land converted to forest land (including afforestation and natural forest expansion). Projections of afforested areas and areas under natural forest expansion were estimated considering the goal of forest coverage increase up to 35 % by 2030. Currently there are 4 measures that will increase the forest area or will help to form productive forest stands. All these measures will cover more than 25 thous. ha area. Actual converted areas were taken to estimate preliminary changes for the projections of 2023. Afterwards, starting in 2023, annual land converted to forest land area is projected to be 7.1 thous. Ha, 2024 – 12.9 thous. ha, 2025–2027 – 8 thous. ha, 2028-2030 – 7.1 thous ha, and afterwards 1.9 thous. ha.

Cropland, Grassland, Wetlands, Settlements and Other land. Remaining areas will remain relatively the same as in 2022 in these land categories. It is assumed that implemented measures will help to decrease the conversion rate from grassland to cropland by 2030 and increase conversion rate in other direction afterwards. The projected area for sustainable agriculture practices is increased to 1,027 thous. ha by 2027, which includes cover crop, no-till and crop rotations. Furthermore, measures to convert organic soils areas from croplands to wetlands will be implemented and the planned area is 6 thous. ha by 2027. Another planned measure is planning to protect or restore grasslands. The focus are for areas that are under danger of being converted to croplands and in turn the loss of natural grassland habitats.

Harvested wood products. Due to projected increasing harvest (as a result of aging forests), the projected felled volume was applied to estimate relative increase in wood commodities, compared to the recent data available (2022). The same distribution between wood commodities was maintained for the projections as preliminary reported for 2021, as well as share between total harvested wood volume used for energy and non-energy purposes, used for harvested wood volume carbon stock changes estimation.

4.5.2.2. Scenario "with additional measures" (WAM)

Forest land remaining forest land. Measure for restoration of organic soils in forest land is being planned to implement in the WAM scenario. This measure will cover over 4 thous. ha area in Natura 2000 habitats.

Land converted to forest land. Currently there is a planned measure to include self-seeded forest areas into forest cadastre. This would legally protect these areas from deforestation and occurring emissions from such areas. This measure will cover over 19 thous. ha.

Cropland, Wetlands. Measures to convert organic soils areas from croplands to wetlands will be implemented and the planned area is 2 thous. ha from 2026 to 2030. This measure is an extension of the same measure that is being implemented under WEM scenario.

Grassland, Settlements and Other land. GHG emissions are the same as reported under WEM scenario.

4.5.3. Projections of GHG emissions and removals

Two scenarios were elaborated: with existing measures (WEM) and with additional measures (WAM). Projection of GHG emissions and removals in LULUCF sector include all relevant categories and subcategories as reported for the EU and the UNFCCC for LULUCF sector, including all relevant parameters such as land-use area, annual carbon stock change in living biomass, annual carbon stock change in dead wood and litter, carbon stock change in mineral and organic soils, implied emission factors for drainage of soils and burning of biomass, etc. Carbon stock changes and GHG emissions/removals in forest land were calculated for above and below-ground biomass, dead wood and harvested wood products applying projected growing stock volume change, felled and naturally dead trees' volume. For the estimation of GHG emissions/removals calculation spreadsheets as used in annual GHG inventory were applied with national and default factors, using 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Total projections of GHG emissions and removals from LULUCF sector under WEM and WAM scenarios are provided in Figure 4-22. It is clear from the Figure that both for WEM and WAM scenarios a rather stable LULUCF carbon sink is projected until 2045. Stableness can be explained with decreasing GHG removals in forest land remaining forest land biomass due to the aging forest

stands, but also to increase in sustainable cropland management introducing no-till technology, cover or rotation crops. After 2045, sinks are projected to decline, because of exhausted effect of sustainable cropland management, while also facing decreasing GHG removals in forest land.

In order to define the most accurate development for each of the sector's categories the following policies were taken into account preparing estimations of projections with existing measures:

- The Strategy for the National Climate Change Management Policy;
- Inter-institutional Action Plan on the implementation of the Goals and Objectives of the Strategy for the National Climate Change Management Policy;
- National Energy and Climate Action Plan of the Republic of Lithuania for 2021–2030 (NECP).

For the estimation of projections with additional measures (measures under discussion, not adopted) NECP was considered, as well as assumption of forest land increase (forest cover could reach 35% by 2030).

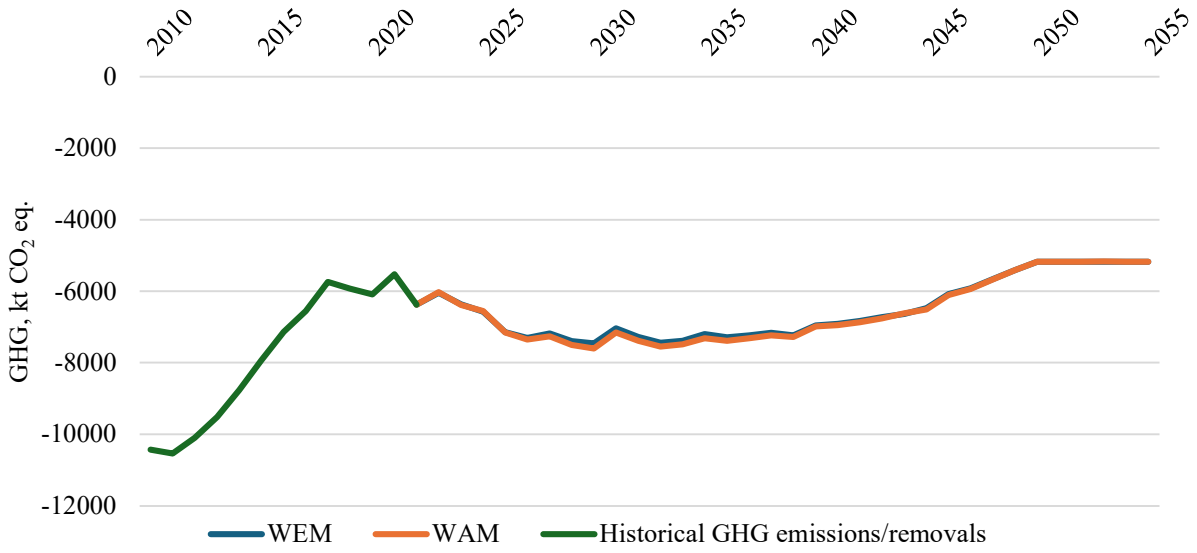

Figure 4-23. Total GHG emissions and removals from LULUCF sector under WEM and WAM scenarios

Lithuania is using 2006 IPCC Guidelines for GHG emissions and removals estimation in LULUCF sector and GHG projections as well, while 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands are not yet implemented since it is not mandatory in this commitment period.

4.5.3.1 Scenario "with existing measures" (WEM)

Measures from previous WAM scenario shifts to WEM scenario. This means that, according to the WEM scenario forest land area should reach 35% of the total country area in 2030 as was forecasted in NECP. It was assumed that due to the implementation of measures for afforestation/reforestation activities, listed in NECP, land conversion to forest land will remain as determined in base year, therefore total forest land area should increase approx. 6.8 thous. ha from 2023 to 2027, afterwards it will fall to 6.1 thous. ha to 2030, and the land conversion rate to forest will fall even more after 2030. Felling rates will significantly increase from 10.72 mill. m^3 in 2018 to 11.59 mill. m^3 in 2040. Thus, the potential of harvesting will be better exploited in Lithuania, considering the increasing area of mature forest stands. There are planned measures for increase of forest are on private and state land.

The last measure that considers forests, is reconstruction of low-value forests. Short-term effect should be negative (there will be decrease in absorptions), but in a long-run effect will be positive. There is a planned measure to increase carbon storage in harvested wood products, by starting to produce modular wood packets. It will help to redirect wood, which would have been exported towards the national market.

Cropland area is projected to have minor increase, while grassland – minor decrease. Higher conversion rate is projected to be from grassland to cropland than vice versa. The conversion rate was projected from average conversion rate in period 2015–2020. The shift from emissions to absorptions in cropland is because of introduced sustainable land management practices – no-till, cover and rotation crops, which will help to sequestrate organic carbon into mineral soils. The grasslands in the whole period will remain as a carbon sink, thanks to the stable area and land conversion from croplands. Increasing GHG removals in whole LULUCF sector are projected during 2023–2055 from -6,374.7 kt CO_2 eq. in 2022 to -5,173.2 kt CO_2 eq. in 2055.

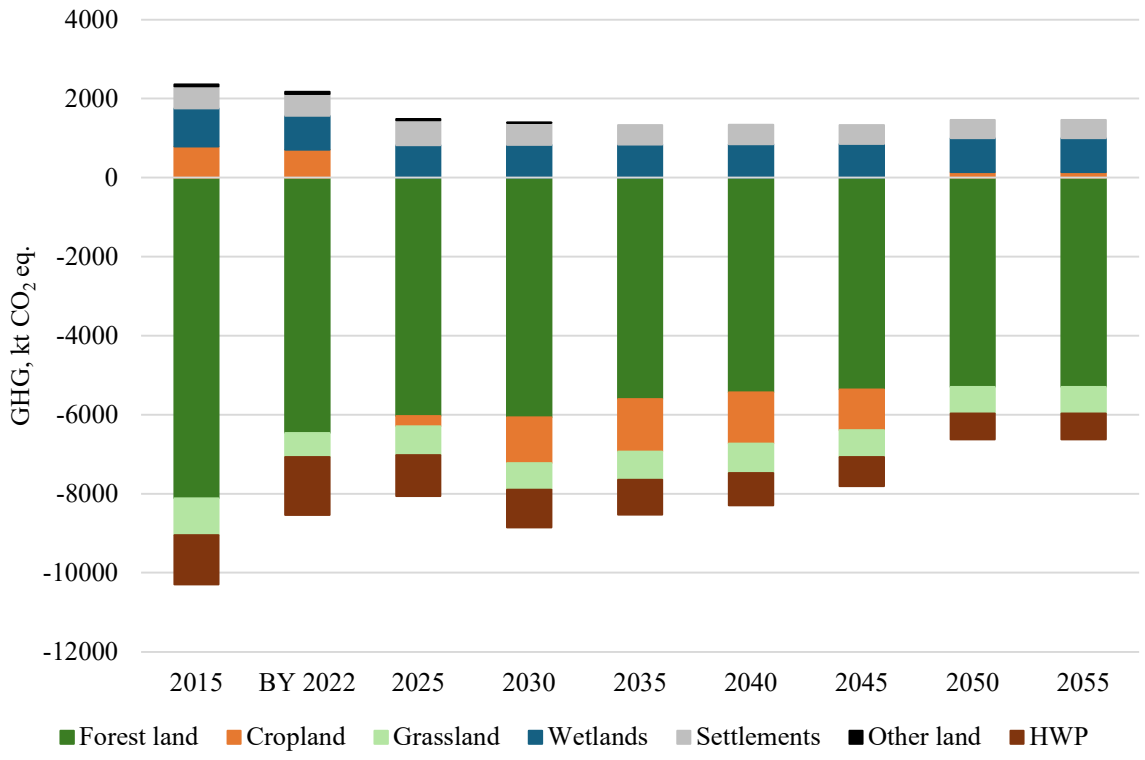

Figure 4-24. Historical (1990–2022) and projected (2023–2055) GHG emissions and removals from LULUCF sector (WEM scenario)

4.5.3.2. Scenario "with additional measures" (WAM)

WAM scenario is not as ambitious as WEM scenario, but it also contains measures, that will help to increase absorptions in LULUCF sector. The highest possible effect can be expected from measure, which projects increase on conversion of self-seeded areas to forest land, as this measure should cover 19 thous. ha. Cropland area is not expected to increase in this scenario. Total cropland emissions are projected to decrease until 2045. It is expected that grassland category will act as a net sink over 2023-2055 period adding a significant value to the total LULUCF GHG removals. LULUCF WAM scenario projections provide higher and increasing net sink of GHG removals during 2023–2055 from -6,374.7 kt CO_2 eq. in 2022 to -5,173.6 kt CO_2 eq. in 2055.

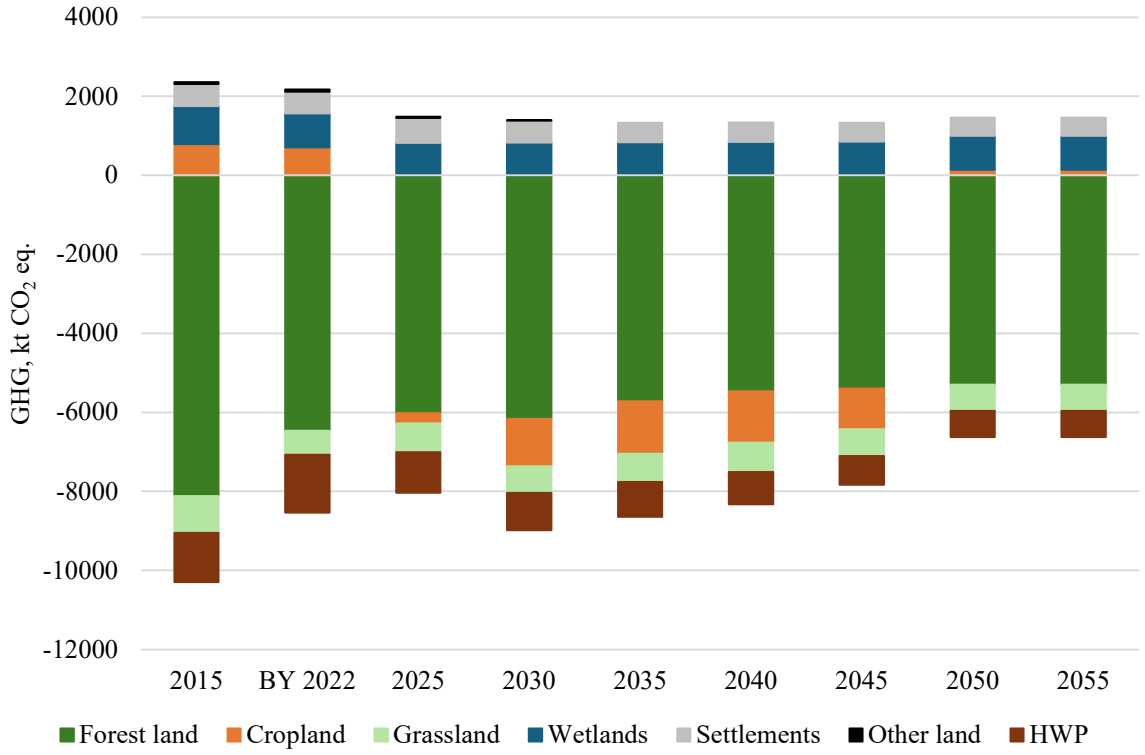

Figure 4-25. Historical (1990–2022) and projected (2023–2055) GHG emissions and removals from LULUCF sector (WAM scenario)

4.5.3.3. Accounted emissions and removals from LULUCF sector

In accordance with the commitment under Regulation (EU) 2018/841, the annual difference in GHG emissions and removals in the LULUCF sector (by applying the special accounting rules provided for in this Regulation) has to be negative, i.e. the sector has to generate more removals than emissions or at least the cumulative quantity of GHG removals and emissions has to be equal to zero starting from 2021. The cumulative quantity of GHG emissions and removals is accounted for by deducting the fixed reference levels from GHG removals or emissions calculated in the categories of annually managed forest land, managed cropland and managed grassland in the period from 2021 to 2030 and adding the quantity of GHG removals or emissions from afforested and deforested land. The reference level for managed forest land means projected GHG removals or emissions from forests, based on forest use tendencies between 2000 and 2009 and the structure of stand age classes for that period. The established indicative reference level of managed forest land (GHG removals of -5,164.6 kt CO_2 eq./year) is set in the Commission Delegated Regulation. Reference levels for managed cropland and managed grassland and pastures are the average of GHG emissions/removals between 2005 and 2009. The calculated reference level for managed cropland reaches 1,868.5 kt of GHG emissions of CO_2 eq./year, and the reference level for managed grassland and pastures is -1,509.8 kt of GHG removals of CO_2 eq./year.

Taking into the account of the accounting rules under Regulation (EU) 2018/841 for the first period from 2021 to 2025, Lithuania's LULUCF sector is projected to generate an average of -1,890.9 kt CO_2 eq. of GHG removals each year in the period from 2021 to 2025 under WEM scenario, part of which can be used to meet the GHG emission reduction commitments by the non-ETS sectors. From 2026 to 2030, Lithuania's LULUCF sector has different accounting system for removals, that can be used by the non-ETS sectors. Currently it is projected to accumulate 2,248.9 kt CO_2 eq. total shareable removals under WEM scenario. According to the projected and accounted GHG emissions and

removals under WAM scenario, potential credits from the LULUCF accounting categories could be up to -1,884.5 kt CO_2 eq. of GHG removals each year for 2021–2025 period and 2,623.5 kt CO_2 eq. of GHG removals each year for 2026–2030 period.

Table 4-25. *Accounted emissions/removals from LULUCF accounting categories as set in Regulation (EU) 2018/841*

Category	Scenario	Total cumulative emissions/removals (kt CO_2 eq.)	
		2021–2025	***2026–2030***
LULUCF: Afforested land	WEM	-5,961.29	
LULUCF: Deforested land	WEM	206.17	
LULUCF: Managed cropland	WEM	1,481.93	
LULUCF: Managed grassland	WEM	-583.97	
LULUCF: Managed forest land, including harvested wood products	WEM	-4,597.23	
LULUCF: Managed forest land, including harvested wood products assuming instantaneous oxidation	WEM	827.46	
LULUCF: Managed wetland	WEM	NA	
		2021–2025	***2026–2030***
LULUCF: Afforested land	WAM	-5,998.82	
LULUCF: Deforested land	WAM	207.68	
LULUCF: Managed cropland	WAM	1,481.03	
LULUCF: Managed grassland	WAM	-583.67	
LULUCF: Managed forest land, including harvested wood products	WAM	-4,528.62	
LULUCF: Managed forest land, including harvested wood products assuming instantaneous oxidation	WAM	896.07	
LULUCF: Managed wetland	WAM	NA	

4.6. Waste

This chapter includes information on the methods used for greenhouse gas projections, as well as assumptions on activity data considering the existing and planned waste management and treatment policies and measures. The projections described in this chapter include projections on Solid Waste Disposal, Biological Treatment of Solid Waste, Waste Incineration and Wastewater Treatment and Discharge.

These sources results emissions of methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). Major source of CH_4 emissions is Solid Waste Disposal and Wastewater Treatment and Discharge, source of N_2O is human sewage and source of CO_2 is Waste Incineration.

4.6.1. Overview of the waste sector

Solid Waste Disposal on land including disposal of sewage sludge is the largest GHG emission source from Waste Sector. It contributed around 70% of the total GHG emission from Waste Sector in 2022.

GHG emissions occurring due to solid waste and sewage sludge disposal on land were increasing slightly from 1990 to 2001 and then started to decrease due to reduction of disposed waste, extraction of landfill gas and anaerobic digestion.

To achieve targets, set in the National Waste Management Plan, in 2015 mechanical and/or mechanical-biological waste treatment (MBT) facilities started to operate. In 2013, first waste incineration plant in Lithuania has started operation with energy recovery. The cogeneration power plant (CHP) began operating in Kaunas in 2020, followed by another CHP plant in Vilnius in 2021.The reduction of amount of waste disposed in landfills has been significant (1.8 time) since the launch of MBT plants as biodegradable waste separated during pre-treatment undergoes either biological treatment or is incinerated. Moreover, to encourage resource efficiency in waste management and divert waste from landfill a landfill tax has been introduced from January 2016.

Biological Treatment of waste includes composting and anaerobic digestion. In the initial stage up to year 2011 the amount of composting waste, though gradually increasing, remained comparatively low. From 2011, establishment of regional waste management systems and construction of new waste management facilities resulted in significant intensification of waste composting activities. In 2016 regional MBT facilities were put into operation resulting in another upsurge of waste composting activities.

Wastewater Treatment and Discharge contributed around 18% of GHG emissions from Waste Sector in 2022. Wastewater in Lithuania is treated in aerobic treatment systems with minimum CH_4 generation. However, 23% of population still does not have connection to public sewerage systems and emissions from sewage collected from septic tanks are significant.

Waste Incineration without energy recovery is used in Lithuania on comparatively small scale contributing during the period 1990–2022 on average 0.1% of the total waste GHG emission.

In 2022 total GHG emissions in Waste Sector contributed 821 kt CO_2 eq. which are 4% of the total GHG emission in 2022 (excl. LULUCF).

The share of GHG emissions from waste sector by subsectors is presented in the figure below.

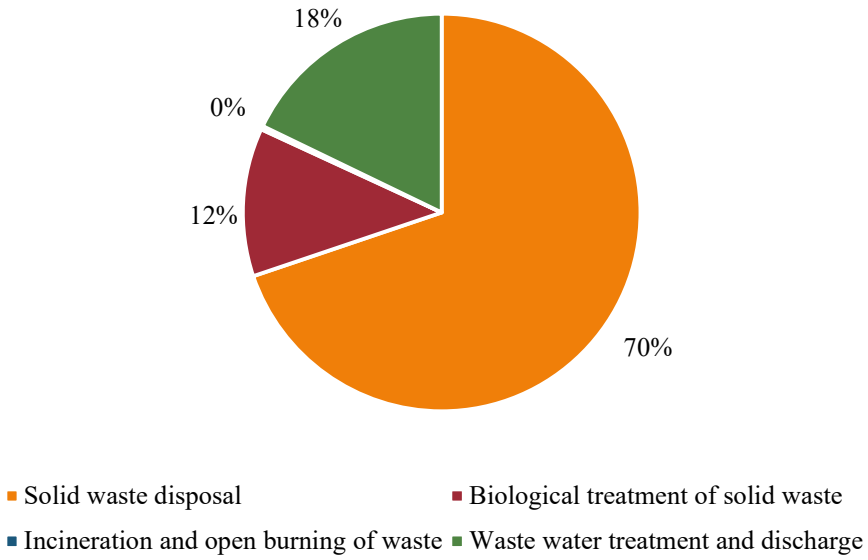

Figure 4-26. The share of GHG emissions by subsectors in waste sector (%)

In 2022 total GHG emissions resulting in waste sector decreased approximately by 50% compared 1990 level.

4.6.2. Methodologies and key assumptions

Methane emission arising from *Solid Waste Disposal* on land is calculated applying the IPCC (Intergovernmental Panel on Climate Change) Tier 2 (First Order Decay) method, considering historical waste disposal data. This method assumes that the degradable organic component in waste decays slowly throughout a few decades. CH_4 is generated as a result of degradation of organic material under anaerobic conditions. Part of the CH_4 generated is recovered for energy; therefore, CH_4 actually emitted part is smaller than the generated. The model calculations are performed using national statistics of landfill site characteristics and amounts of waste fractions deposited each year. The parameters used for emission projections are the same as those used in the Lithuanian GHG inventory.

Biological Treatment of waste covers composting of green waste, composting and anaerobic digestion in MTB plants and household composting. Methane and nitrous oxide emissions from Biological Treatment of waste are calculated by multiplying the amount of waste by the emission factors (see the table below). CH_4 emissions from anaerobic digestion are calculated using the IPCC 2006 default EF of 5% CH_4 of biogas produced.

Table 4-26. *Emission factors from biological treatment of waste (IPCC default)*

Type of biological treatment	CH_4 EF (g CH_4/kg waste treated)	N_2O EF (g N_2O/kg waste treated)
Composting	10	0.6

Methane is generated from *Wastewater Treatment* in anaerobic conditions while nitrous oxide can be produced as nitrification and denitrification product in both aerobic and anaerobic conditions. Wastewater treatment and Discharge covers CH_4 emissions from wastewater transportation and treatment as well as from septic tanks not connected to centralized sewer networks and N_2O emissions from human sewage. CH_4 and N_2O emissions are calculated applying IPCC Tier 1 and Tier 2 methods, using IPCC default values.

Carbon dioxide, CH_4 and N_2O emissions from *Waste Incineration* are calculated based on the IPCC Tier 1 method and default emission factors are applied. Emission factors are consistent with the emission factors used in the Lithuanian GHG inventory.

Summary table of assessed emissions from waste sector, method applied, and emission factors is provided below.

Table 4-27. *Methods and emissions factors used to estimate emission from waste sector*

CRF	Source	Emissions reported	Methods	Emission factor
5.A	Solid Waste Disposal	CH_4	T2	D
5.B	Biological Treatment of Waste	CH_4, N_2O	T1	D
5.C	Incineration and Open Burning of Waste	CO_2, CH_4, N_2O	T1	D
5.D	Wastewater Treatment and Discharge	CH_4, N_2O	T1, T2	D

Waste Sector GHG emissions projections are based on the existing measures (National Waste Management Plan[17] for 2014–2020) and planned measures in the National Waste Prevention and

[17] https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.164386/oIeHHUCOaE

Management Plan[18] for 2021–2027, the targets set in the Landfill Directive[19], and data provided by the Ministry of Environment, the Environmental Protection Agency[20], and the Regional Waste Management Centres[21].

4.6.2.1. Scenario "with existing measures" (WEM)

Solid waste disposal on land

Solid waste disposal on land, including stored sewage sludge, is the most significant GHG emission source from the waste sector. Projections of waste generation are based on historical as well as projected data on the population and GDP. The data on population trends was gathered from State data agency, the GDP trend from the European Commission.

The revised legislative proposals on waste set clear targets for reducing waste and establishing an ambitious and credible long-term path for waste management and recycling. Lithuania sets ambitious targets for waste management and recycling by 2030. Lithuania expects to recycle and compost 65% of the total generated municipal waste, incinerate in cogeneration power plants 30% and dispose of in the landfills only 5%. Assumptions are thus in line with the assumptions made for developments of mechanical-biologically treated waste reported under sector Biological Treatment of waste. Some minor amounts of sludge are expected to be stored as well. Assumptions on the projected amounts of sludge are based on historical data. The projected data on waste generation, population and GDP are presented in the table below.

Table 4-28. *Base year and projected amount of waste generation, populations and GDP*

Parameter	Units	BY2022	2025	2030	2035	2040	2045	2050	2055
Generation of municipal waste	kt	1,317	1,233	1,170	1,122	1,087	1,058	1,031	1,007
Population	millions	2.83	2.86	2.74	2.62	2.52	2.43	2.34	2.25
GDP	EUR million	58,082	61,389	67,048	72,012	76,968	80,943	84,242	85,981

Constantly decreasing share of CH_4 recovery from landfills is assumed due to the decreasing gas generation potential of deposited waste.

Biological treatment of solid waste

EU structural and investment funds are an important source of funding for municipal waste management infrastructure development. Implementing EU funded projects 9 sewage sludge, 55 green waste composting facilities, 1 mechanical sorting and 8 regional mechanical sorting and biological treatment plants were constructed by 2018.

Regional Waste Management Centers provided the projected data on the amount of composted waste and waste treated in anaerobic digestion plants. The amount of waste undergoing mechanical-biological treatment assumed to increase as separate kitchen and food waste collection is foreseen

[18] https://www.e-tar.lt/portal/legalAct.html?documentId=f6c980d0e1af11ec8d9390588bf2de65
[19] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01999L0031-20180704
[20] The Environmental Protection Agency. Available at: http://gamta.lt/cms/index?lang=en
[21] The Regional Waste Management Centres. Available at: http://ratca.lt

since the year 2024. Household composting was evaluated by the number of composting bins distributed and the amount of composted waste (220 kg) per household.

Activity data for biological waste treatment is presented in the table and figure below.

Table 4-29. *Projected amount of waste undergoing biological treatment*

	BY2022	2025	2030	2035	2040	2045	2050	2055
Total amount of waste, kt	312	371	372	384	389	389	389	389

Wastewater treatment and discharge

EU structural and investment funds are an important source of funding for water sector. In 2007–2013 around 570 million EUR were invested into the wastewater collection and treatment system, focusing on the cities with more than 2,000 inhabitants. In 2014–2020, around 125 million EUR were invested into wastewater collection and treatment system, focusing on the small town and villages with 200–2,000 inhabitants. In 2021–2027 it is planned further to invest 139 mill. EUR from EU Cohesion fund. These investments will help to further develop wastewater collection and treatment systems.

Biochemical oxygen demand (BOD) is one of the main parameters for assessing discharged wastewater compliance with requirements for discharges from urban wastewater treatment plants. BOD data was predicted based on historical data as well as the future development of wastewater collection and treatment system. BOD is expected to increase in line with the rising percentage of population connected to wastewater collecting system. The projected data on BOD and percentage of population connected to wastewater collecting system has been provided by the Ministry of Environment.

The main parameter to estimate N_2O emissions from human sewage is protein consumption. Protein consumption per capita was evaluated by the Health education and disease prevention Centre (28.3 kg/capita/year in 1998, 28.5 kg/capita/year in 2002, and 29.9 kg/capita/year in 2007, 23.2 kg/capita/year in 2013, 25.6 kg/capita/year in 2020). The protein consumption is left as 2020 and remains stable during the 2023–2055 period.

Incineration of waste

Waste incineration without energy recovery is the smallest source of GHG in the waste sector and it is not expected to expand. Assumptions on the projected amounts of incinerated hazardous and clinical waste are based on historical data.

Cogeneration power plant has started incineration of MSW in 2013 and two additional MSW incinerators are in operation since end of 2020. It is assumed that operation of three MSW power plants will reduce the amount of MSW disposed of by landfilling and will overlay portion of fossil fuel used in public electricity and heat production sector. This assumption was incorporated in the final fuel used in the energy sector.

4.6.2.2. Scenario “with additional measures” (WAM)

Lithuania is taking steps towards realising the concepts of “recycle, repair and re-use” and avoiding waste at all stages of the value chain with its EU circular economy package. The 2015 Circular Economy Package emphasizes the need to move towards a lifecycle-driven “circular” economy, with a cascading use of resources and residual waste that is close to zero.

This can be facilitated by the development of, and access to, innovative financial instruments and funding for eco-innovation. Sustainable development goals (SDG) 8 invites countries to promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all. SDG 9 highlights the need to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. SDG 12 encourages countries to achieve the sustainable management and efficient use of natural resources by 2030.

4.6.3 Projections of GHG emission

4.6.3.1 Scenario "with existing measures" (WEM)

GHG emissions projections are provided in four subsectors: disposal in landfills, biological treatment of solid waste, incineration of waste and wastewater treatment and discharge. In the WEM scenario the amount of waste disposed in landfills is expected to continue a decreasing trend, mainly as a result of the requirements of the Landfill Directive, but also because waste incineration and other forms of treatment are becoming more important.

Historical and projected GHG emissions are presented in the table and figure below.

Table 4-30. *Projected GHG emissions from waste sector (kt CO_2 eq.)*

	BY2022	2025	2030	2035	2040	2045	2050	2055
Solid waste disposal*	573	485	334	234	171	127	96	73
Biological treatment of waste	99	109	109	111	111	111	111	111
Waste incineration	2	2	2	2	2	2	2	2
Wastewater treatment and discharge	146	96	65	57	50	44	38	32
Total	**821**	**693**	**510**	**405**	**335**	**285**	**247**	**219**

**Including emissions from sewage sludge and CH_4 recovery*

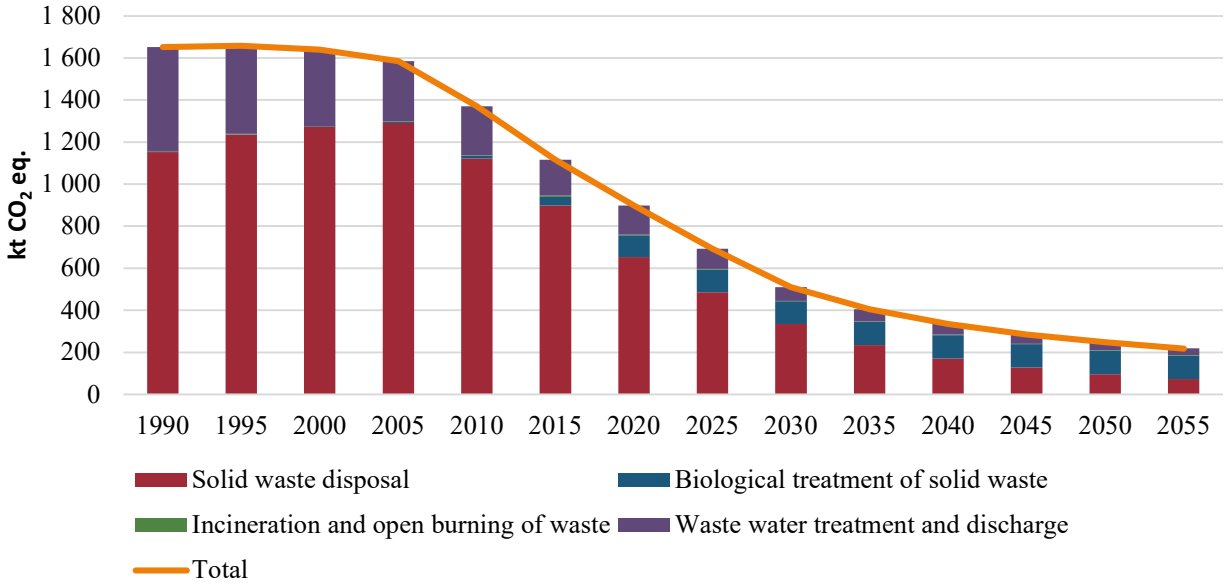

Figure 4-27. Historical and projected GHG emissions from waste sector

Solid waste disposal on land

GHG projections were estimated based on the assumption that national targets such as reduction of the quantity of landfilled waste, increase of biodegradable waste composting, increase of the

recovered gas use for energy will be achieved. These targets will be achieved through the implementation of existing measures. Implementation of these measures will lead to gradual reduction of CH_4 emissions and will reach 73 kt CO_2 eq. (incl. CH_4 recovery) by 2055.

Biological treatment of solid waste

One of the main national targets is to reduce the amount of biodegradable waste going to landfills; for this reason, the mechanical-biological treatment plants have been launched in 2016. As was expected, the amount of biodegradable waste going to landfills was reduced, resulting in lower emissions. However, the GHG emissions from the biological treatment of waste will grow due to the increase in treated waste.

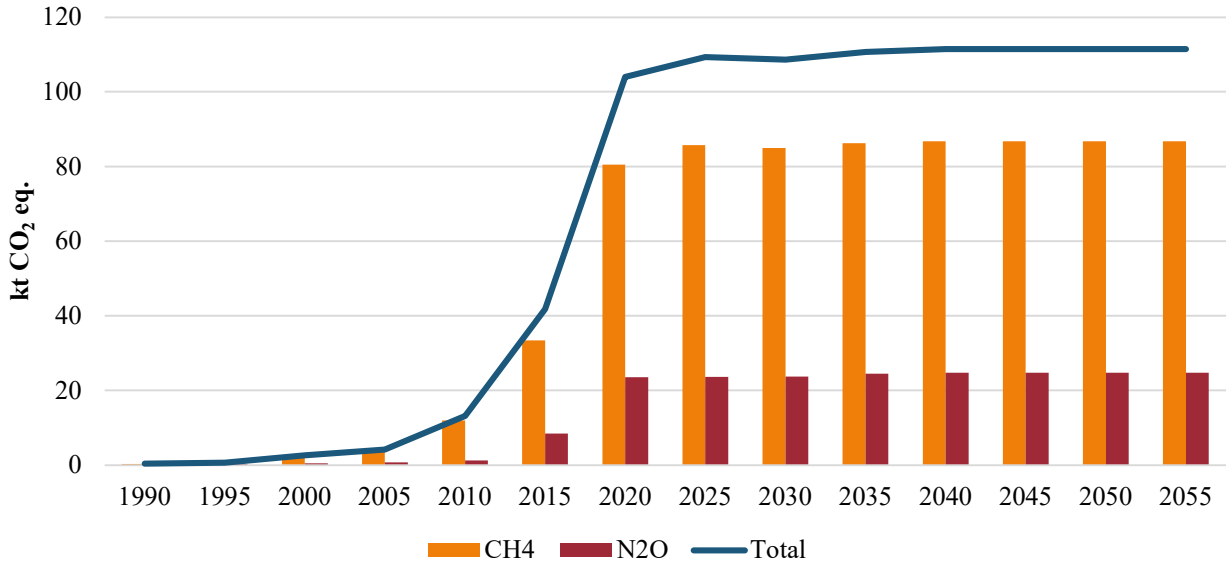

Figure 4-28. Historical and projected emissions from biological treatment of waste

Wastewater treatment and discharge

There are close to 1,800 wastewater discharge points in Lithuania. 99% of wastewater is treated in centralized aerobic wastewater treatment plants. The main source of CH_4 emissions is septic tanks. CH_4 emissions will decrease due to increased population connected to centralized sewer networks and are projected to be 25 kt CO_2 eq. by 2055.

The N_2O emissions from human sewage were calculated based on the protein consumption constant value. Emissions will drop due to a decrease in the population, and it is projected to be 7 kt CO_2 eq. by 2055.

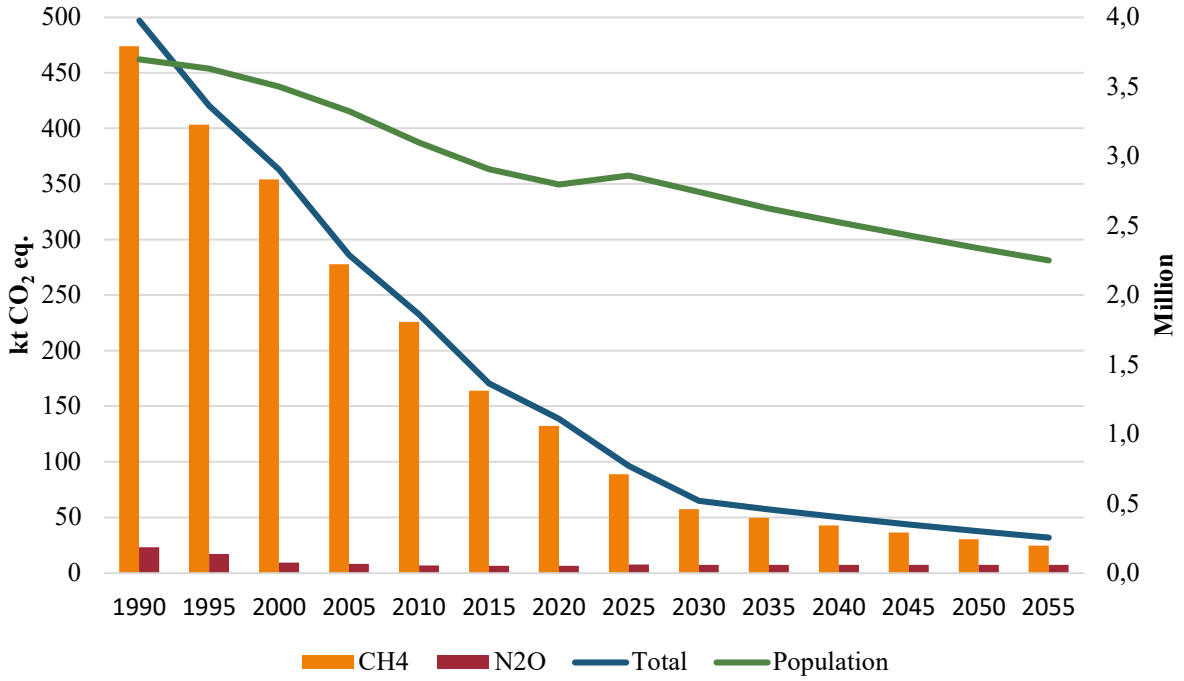

Figure 4-29. Historical and projected CH_4 and N_2O emissions and projected population

Incineration of waste

Emissions from waste combustion for energy recovery are reported in the energy sector. In general, municipal, industrial and hazardous wastes are combusted for energy recovery. Only small amount of hazardous waste is incinerated without energy recovery.

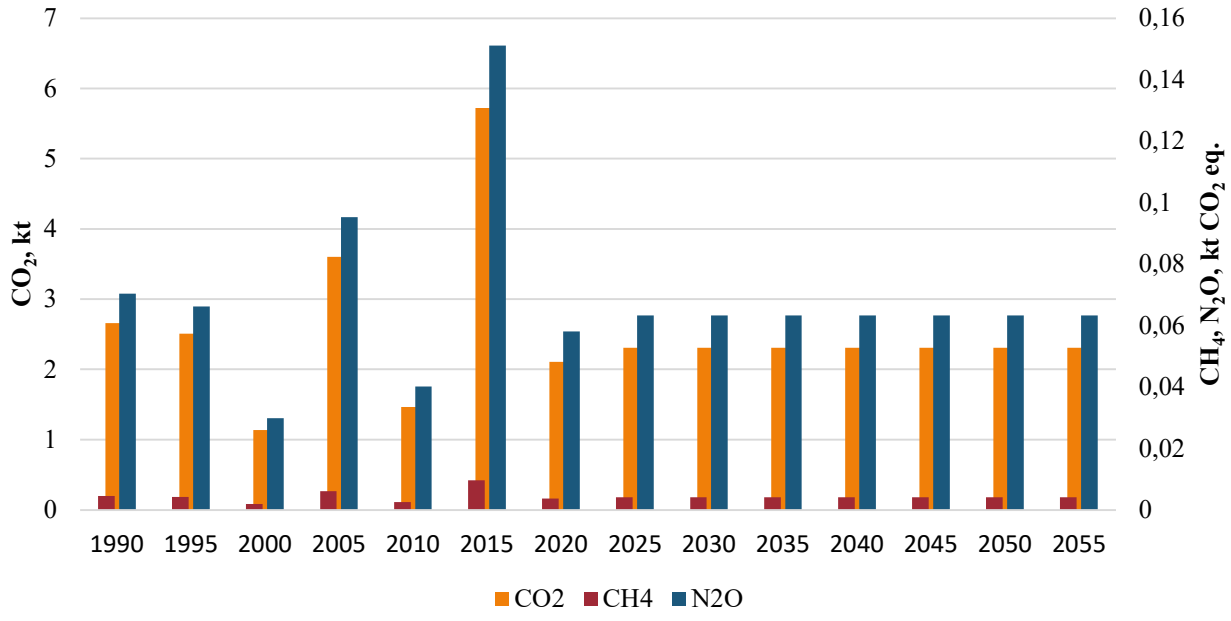

Figure 4-30. Historical and projected emissions from waste incineration

4.6.3.2. Scenario “with additional measures” (WAM)

The WAM scenario is based on the additional measures provided by the Ministry of Environment, the implementation period of measures will cover period of 2025–2030. For the period of 2031– 2055 all additional measures will continue to be implemented at the same rate as it is expected in 2030.

To further reduction of the amount of waste disposed of, it is planned to set some regulatory changes related to household composting.

The emissions from Waste sector for WEM and WAM scenarios are presented in the table below.

Table 4-31. *Projected GHG emissions in case of WEM and WAM scenarios (kt CO_2 eq.)*

	2025	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**
WEM scenario	693	510	405	335	285	247	219
WAM scenario	690	502	397	327	277	240	211
Difference (WEM-WAM), ktCO_2 eq.	3	8	8	8	8	7	8
Difference (WEM/WAM), %	0.3%	1.5%	1.9%	2.3%	2.7%	3.1%	3.5%

4.7. Sensitivity analysis

Sensitivity analysis in IPPU, Agriculture and Waste sectors has been done using main parameters used in EU REF scenario[22] and from Recommended parameters for reporting on GHG projections in 2025. These parameters were used in one scenario (SEN) in sensitivity analysis, provided as "Scenario 1". On the contrary, sensitivity analysis in LULUCF sector is provided in another scenario "Scenario 2" as this sector is not included in Total ESR emissions. Sensitivity of EU ETS carbon price is provided in "Scenario 3" because ETS carbon price is obtained not from EU REF scenario, but from Recommended parameters for reporting on GHG projections in 2025.

4.7.1. Energy sector

An important parameter in preparing GHG emissions projections can be considered the EU ETS carbon price. Most of installations under the EU ETS are local districts' heat providers. From the start of the 3rd EU ETS trading period many smaller installations producing heat energy started to switch from fossil fuel to biomass. This can be explained by the fact that the European Commission proposed the EU ETS market back-loading solution to decrease the surplus of European Union Allowances (EUAs) in the market and therefore increase carbon price. Therefore, the switch to biomass may greatly reduce the amount of EUAs needed for installations to cover the GHG emissions or even opt out from the EU ETS. The EU ETS carbon prices used in sensitivity analysis for the EU ETS sectors are presented in the table below.

Table 4-32. *Carbon price used for GHG sensitivity analysis*

Carbon price (in constant €2023/t CO_2)								
	BY 2022	2025	2030	2035	2040	2045	2050	2055
Stable price used in projections	86	85	85	85	85	85	85	85
EC recommended[23]	86	95	95	100	100	160	190	220

Results of the EU ETS GHG emissions sensitivity analysis are presented in the figure below.

[22] Non-CO_2 GHG emission scenario using energy sector drivers from the PRIMES Reference v1 scenario (October 2020), agricultural sector drivers from CAPRI scenario 2020 (7 Oct 2020), and drivers for waste, industry and F-gas sectors developed in GAINS in consistency with PRIMES model macroeconomic projections.

[23] Recommended parameters for reporting on GHG projections in 2025.

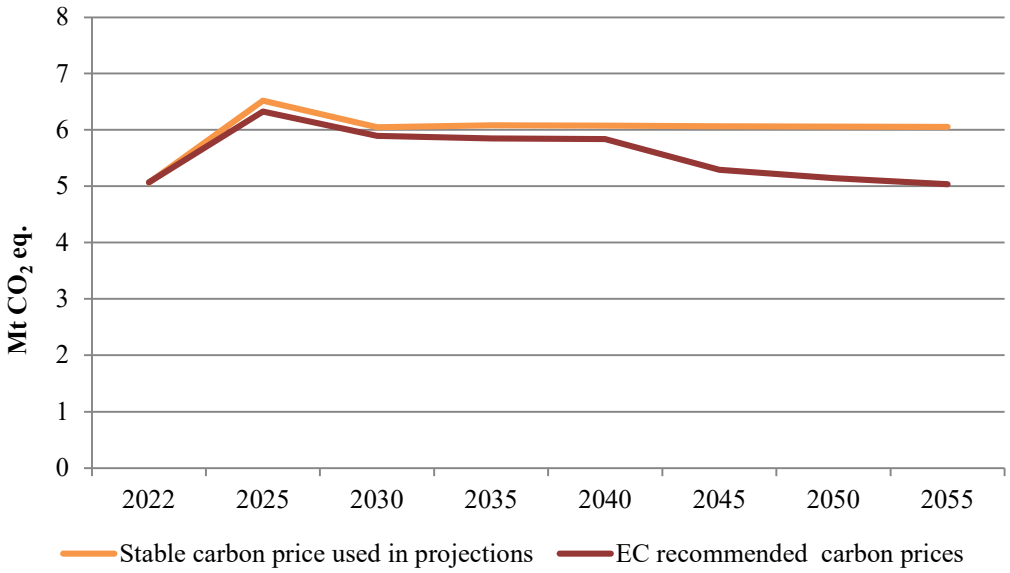

Figure 4-31. Results of carbon price impact on GHG emissions in Lithuania's EU ETS sectors

Sensitivity analysis results showed considerable margin between GHG emissions projected using stable carbon price and increasingly high carbon price in 2055. A distinction can be explained due to increase of expenditures for GHG emissions from installations. The operators will most likely consider switching to use biomass instead of fossil fuels. Also, it is more likely that those operators will start investing in energy efficiency due to not only increased fossil fuel prices, but also due to increasing EUAs price. Only installations with high carbon leakage outside EU risk, obtaining more free EUAs, are not supposed to reduce GHG emissions due to the higher carbon price.

Results show that because of increase of EUAs price up to 220 EUR/t CO_2 the biggest reduction of GHG will be seen in public electricity and heat production sectors and in manufacturing industries and construction sectors. This is because these sectors are exposed to lower carbon leakage risk and there is a potential to replace their combustion units with biomass using units or to change electricity production sources from thermal CHPs into wind or solar power plants.

4.7.2. Transport sector

Sensitivity analysis for IPPU sector emissions is based on scenarios in which nitric acid production volumes (see table below) are projected using data from the European Commission, derived from GAINS model Reference scenario 2021: non-CO_2 greenhouse gas emissions in the EU-27 and the United Kingdom.

Table 4-33. *Values given by European Commission*

Indicator	2022	2025	2030	2035	2040	2045	2050
Number of passenger cars	1,642,451	1,379,289	1,261,439	1,255,489	1,252,533	1,257,497	1,287,992
Number of LDV	74,086	35,555	27,407	25,599	26,457	27,744	29,218
Number of HDV	101,902	50,725	57,938	74,842	82,928	89,416	96,787

Under sensitivity scenario (SEN), numbers of road transport vehicles recommended by EC were implemented in calculations (table below). The methodology for calculating WEM scenario is provided in Chapter 4.2.

Table 4-34. *GHG emissions per category, kt CO_2 eq.*

Category	2025	2030	2035	2040	2045	2050
Road transportation (WEM)	5,422	3,919	3,024	2,669	2,413	2,199
Road transportation (SEN)	4,048	2,578	2,619	2,553	2,525	2,565

Results of sensitivity analysis on the GHG emissions from transport sector (Road transportation) are presented in the figure below.

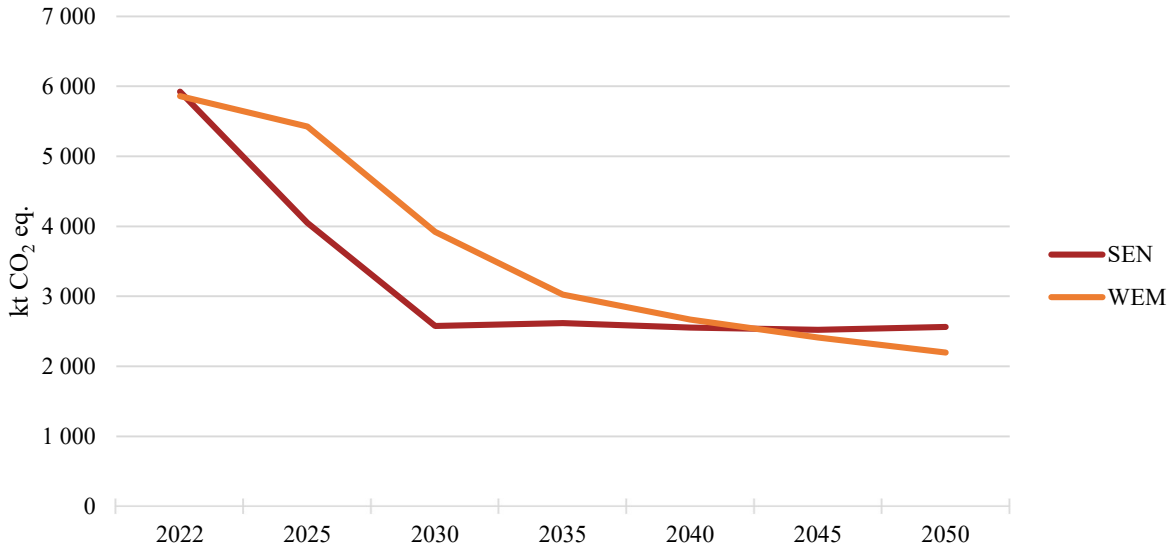

Figure 4-32. Sensitivity analysis for GHG emissions

Transport sector sensitivity analysis showed that using two different datasets (national and European Commission) of projected vehicle number data for GHG projection estimation, the GHG emissions vary by -34/+17% from the WEM assumptions.

4.7.2. Industrial processes and product use sector

Sensitivity analysis for IPPU sector emissions is based on scenarios in which nitric acid production volumes (see table below) are projected using data from the European Commission, derived from GAINS model Reference scenario 2021: non-CO_2 greenhouse gas emissions in the EU-27 and the United Kingdom.

Table 4-35. *Values given by European Commission*

Indicator	2025	2030	2035	2040	2045	2050	2055
Amount of nitric acid production, kt	1,273	1,296	1,310	1,325	1,341	1,354	1,360

Under sensitivity scenario (SEN), amount of and nitric acid production recommended by EC were implemented in calculations (table below). The methodology for calculating WEM scenario is provided in Chapter 4.3.2.

Table 4-36. *GHG emission per subcategory (kt CO_2 eq.)*

Subcategory	2025	2030	2035	2040	2045	2050	2055
Nitric acid production (WEM)	180	180	180	180	180	180	180
Nitric acid production (SEN)	173	176	178	180	183	184	185

Results of sensitivity analysis on the GHG emissions from IPPU sector (Nitric acid production) are presented in the figure below.

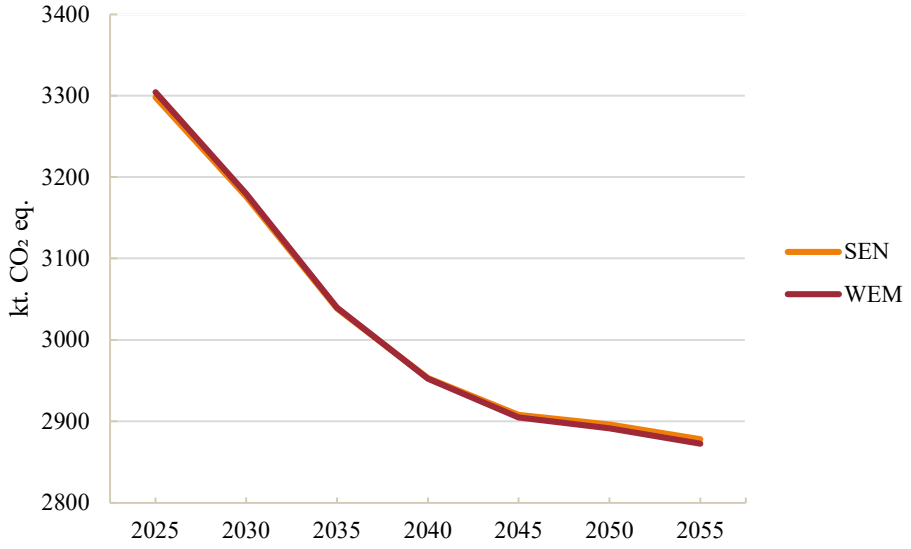

Figure 4-33. Sensitivity analysis for GHG emissions

IPPU sector sensitivity analysis showed that using two different datasets (national and European Commission) of projected nitric acid production activity data for GHG projection estimation the GHG emissions vary by plus and minus 0.2 percentage point from the WEM assumptions.

4.7.3. Agriculture sector

Sensitivity analysis for Agriculture sector emissions is based on the dataset of European Commission GAINS model Reference scenario 2021: non-CO_2 greenhouse gas emissions in the EU-27 and the United Kingdom. As an N_2O emissions from agriculture soils is the major source of agriculture emissions the EC Reference scenario projected activity data for agriculture soils were used for the sensitivity analysis.

Table 4-37. *Values given by European Commission*

Indicator	2025	2030	2035	2040	2045	2050	2055
Agriculture soil data							
Inorganic N fertilizer, kt N	168	169	167	166	166	166	166
Crop residues, kt N	84	84	84	84	84	84	84
Cultivation of histosols, M ha	0.14	0.14	0.14	0.14	0.14	0.14	0.14

Under sensitivity scenario (SEN), activity data provided in the table above recommended by EC were used to estimate GHG emissions form agriculture sector (table and figure below). The methodology for calculating WEM scenario is provided in Chapter 4.4.2.1.

Table 4-38. *GHG emission per subcategory, kt CO_2 eq.*

Subcategory	2025	2030	2035	2040	2045	2050	2055
Agriculture soil (WEM)	1,481	1,412	1,406	1,368	1,343	1,317	1,317
Agriculture soil (SEN)	1,517	1,519	1,513	1,508	1,508	1,508	1,508

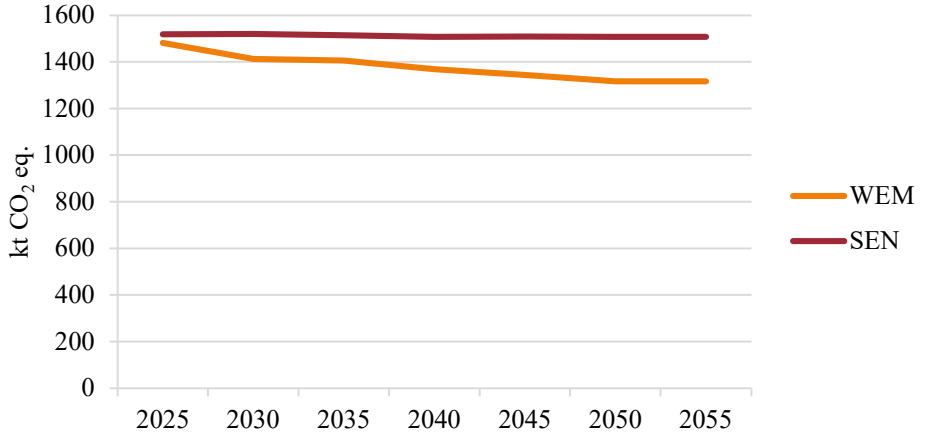

Figure 4-34. Sensitivity analysis for GHG emissions

Agriculture sensitivity analysis showed that using two different datasets (national and European Commission) of projected agriculture soils activity data for GHG projection estimation the GHG emissions differs in the range from 24% to 31%. European Commission dataset projections for the 2025–2055 period are quite stable, however national activity data projections specially consumption of inorganic N fertilizer during the same period is decreasing (about 20%) and as a result, higher decrease of agriculture soils emissions in the WEM scenario could be seen in the figure above.

4.7.4 LULUCF sector

Sensitivity analysis for LULUCF sector emissions is based on the GLOBIOM scenario provided by the European Commission, where growing stock volume changes were estimated according to the values of G4M and GLOBIOM models, provided by the European Commission.

Table 4-39. *Values given by European Commission*

Indicator	2020	2025	2030	2035	2040	2045	2050	2055
Growing stock volume change, thous. m^3	5,925.1	4,567.7	3,206.0	3,458.2	3,705.8	3,979.4	4,188.3	4,188.3

Under sensitivity scenario (SEN), activity data provided in the table above were calculated from data recommended by EC and later used to estimate GHG removals in LULUCF sector (for forest land category); GHG removals in relevant categories and in LULUCF sector are provided in table and figure below. The methodology for calculations of WEM scenario is provided in Chapter 4.5.2.1.

Table 4-40. *GHG removals per subcategory (kt CO_2 eq.)*

Subcategory	2020	2025	2030	2035	2040	2045	2050	2055
Forest land (WEM)	-7,120.2	-5,788.2	-5,690.6	-5,379.8	-5,324.6	-5,361.3	-5,399.2	-5,298.9
Forest land (SEN)	-6,993.7	-4,976.2	-4,173.1	-4,291.0	-4,462.3	-4,713.4	-4,871.8	-4,871.8
LULUCF (WEM)	-5,897.9	-5,401.0	-6,474.2	-6,471.6	-6,296.7	-6,075.7	-4,961.5	-5,173.2
LULUCF (SEN)	-5,771.4	-4,588.9	-4,956.8	-5,382.9	-5,434.5	-5,427.8	-4,434.1	-4,434.1

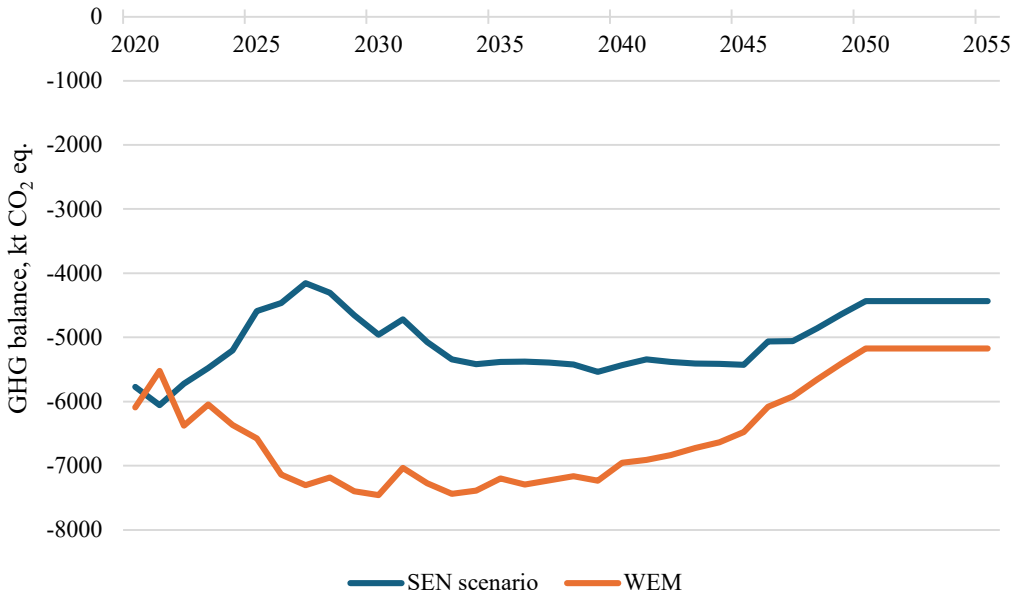

Figure 4-35. Sensitivity analysis for GHG removals in LULUCF sector

Difference between WEM and SEN scenarios comes, because of difference in growing stock volume change in forest land. WEM scenario uses projection from "National Forest inventory 1998–2017" with added correction. Correction coefficient was calculated from updated data of last forest inventory cycle. In SEN scenario, as mentioned before, data recommended by EC was used. No other recalculations were made.

4.7.3. Waste sector

Sensitivity analysis for Waste sector emissions is based on the dataset of European Commission GAINS model Reference scenario 2021: the share of population not connected to centralized wastewater (WW) collection system; European Commission provided assumptions on population (recommended parameters for reporting on GHG projections in 2025) (Table below).

Table 4-41. *Values given by European Commission*

Indicator	Units	2025	2030	2035	2040	2045	2050	2055
Population not connected to centralized WW collection	%	28	27	26	24	22	21	21
Population	million	2.851	2.729	2.612	2.513	2.419	2.329	2.242

Under sensitivity scenario (SEN), population not connected to centralized WW collection system recommended by EC were implemented in calculations (Table below). The methodology for calculating WEM scenario is provided in Chapter 4.6.2.1. A sensitivity analysis revealed that GHG emissions will increase by an 68% on average over the period 2025–2055 if a greater share of the population remains unconnected to centralised WW collection systems. Without proper collection and treatment infrastructure, untreated or poorly treated wastewater can be discharged into the environment, leading to higher levels of pollution.

Table 4-42. *GHG emission (kt CO_2 eq.)*

Subcategory	2025	2030	2035	2040	2045	2050	2055
Wastewater treatment and discharge (WEM)	96	65	57	50	44	38	32
Wastewater treatment and discharge (SEN)	133	110	98	85	74	64	57

Results of sensitivity analysis on the total GHG emissions from waste sector are presented in the figure below.

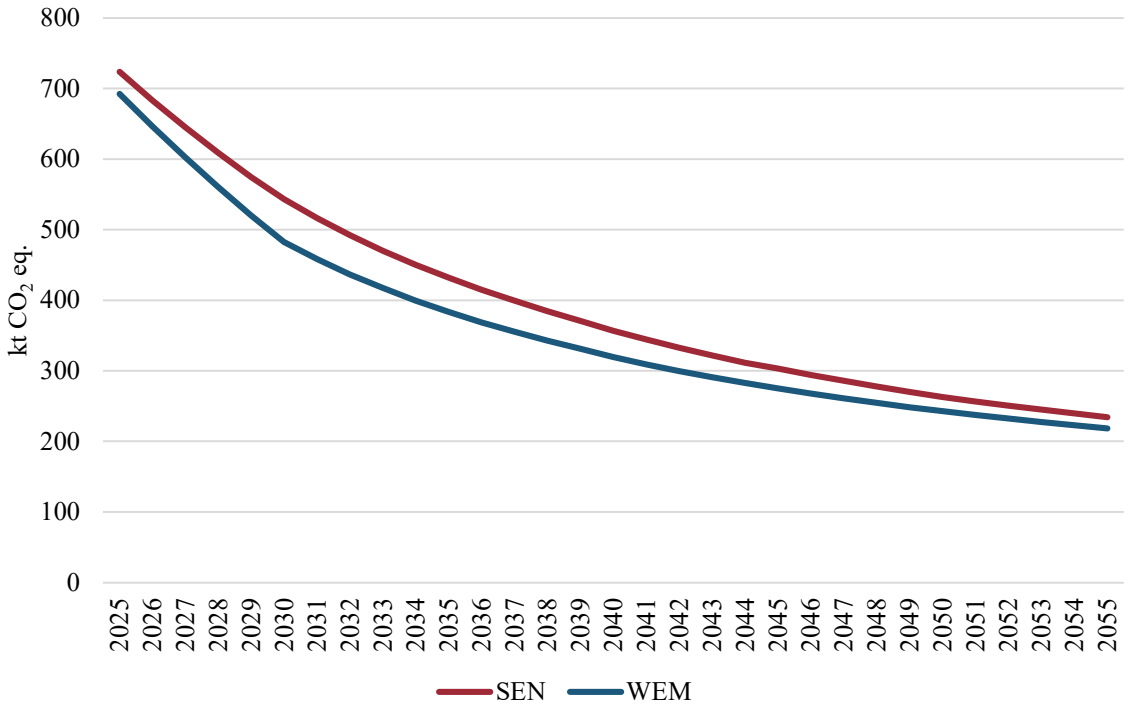

Figure 4-36. Sensitivity analysis for GHG emissions

The waste sector sensitivity analysis showed that using two different datasets (national and European Commission) of projected activity data the GHG emissions differs in the range from 2% to 13%.

4.8. Total projected GHG emissions

For the projections of GHG emissions up to 2055 the base year of 2022 was chosen (NID 2024 submission data). Lithuania provides GHG projections for 2022, 2025, 2030, 2035, 2040, 2045, 2050 and 2055. As a result of global economic crisis national GHG emissions decreased considerably in 2009. In 2010 the GHG emissions as it was expected increased following closure of Ignalina NPP in 2009. However, because of electricity imports and slower economic growth during recovery from crisis period the GHG emissions did not increase further.

GHG emissions projections suggest that decreasing natural gas consumption in electricity and heat production, ongoing GHG reduction measures in Transport sector, as well as decreasing consumption of F-gases and consumption of inorganic N fertilizer for agriculture soils will result in the decrease of GHG emissions. The implementation of additional measures could result in lower GHG emissions if compared WAM and WEM scenarios.

Total historic and projected GHG emissions in Lithuania are presented in the tables below.

Table 4-43. *Projected GHG emissions in case of WEM scenario (kt CO_2 eq.)*

Sector	BY 2022	2025	2030	2035	2040	2045	2050	2055
Energy	11,742	11,259	8,899	8,106	7,712	7,442	7,212	6,995
IPPU	2,320	3,345	3,218	3,077	2,988	2,939	2,924	2,904
Agriculture	4,058	4,124	3,815	3,776	3,705	3,666	3,625	3,625
LULUCF	-6,375	-6,576	-7,457	-7,199	-6,954	-6,479	-5,173	-5,173
Waste	821	693	510	405	335	285	247	219
Total, including indirect CO_2, without LULUCF	18,942	19,420	16,441	15,363	14,739	14,332	14,008	13,743
Total, including indirect CO_2, with LULUCF	12,568	12,845	8,984	8,164	7,785	7,853	8,835	8,570

Table 4-44. *Projected GHG emissions in case of WAM scenario, kt CO_2 eq.*

Sector	BY 2022	2025	2030	2035	2040	2045	2050	2055
Energy	11,742	11,150	7,825	6,920	6,517	6,240	6,002	5,796
IPPU	2,320	3,345	3,218	3,077	2,988	2,939	2,924	2,904
Agriculture	4,059	4,100	3,677	3,609	3,527	3,478	3,440	3,440
LULUCF	-6,347	-6,559	-7,594	-7,312	-6,987	-6,510	-5,173	-5,174
Waste	821	690	502	397	327	277	240	211
Total, including indirect CO_2, without LULUCF	18,942	19,286	15,222	14,003	13,360	12,934	12,606	12,351
Total, including indirect CO_2, with LULUCF	12,595	12,727	7,627	6,690	6,372	6,424	7,432	7,177

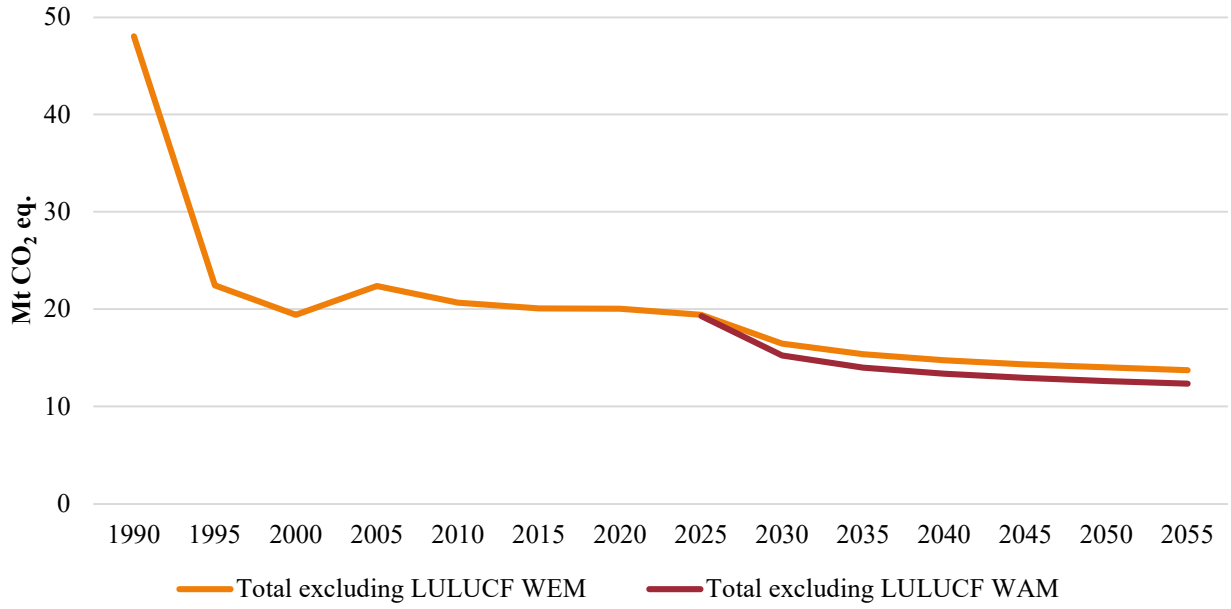

Figure 4-37. Aggregated projected GHG emissions by 2055, Mt CO_2 eq.

According to projected GHG emissions in case of WAM scenario, additional implemented measures will result in total 1,392 kt CO_2 eq. (excluding LULUCF) decrease compared to WEM scenario in 2055. On average, GHG emissions will decrease by 1,184 kt/year over the 2025–2055 period.

4.9. GHG emissions from the EU ETS and ESR sectors

In 2022 the EU ETS emissions in Lithuania amounted to 5,066.3 kt of CO_2 and constituted 26.7% of total GHG emissions in Lithuania (excluding LULUCF). The main sources of the EU ETS GHG emissions are public electricity and heat production, petroleum refining, manufacturing industries and construction as well as emissions from industrial processes. In 2022 the EU ETS scope covered 73 installations and 2 aircraft operators.

For GHG projections the emissions from the EU ETS sectors were calculated according to the emissions reported by installations in 2022 and 2023. Emissions from total 73 installations were distributed according to sectors from which they were originated. These sector-categorized emissions were used as a base for further calculation of the EU ETS GHG emissions in Lithuania up to year 2055. It was assumed that the sector split would remain mostly the same and that the carbon price will not do any impact for GHG emissions.

Results of projected GHG emissions in the EU ETS sectors are presented in the figure and tables below.

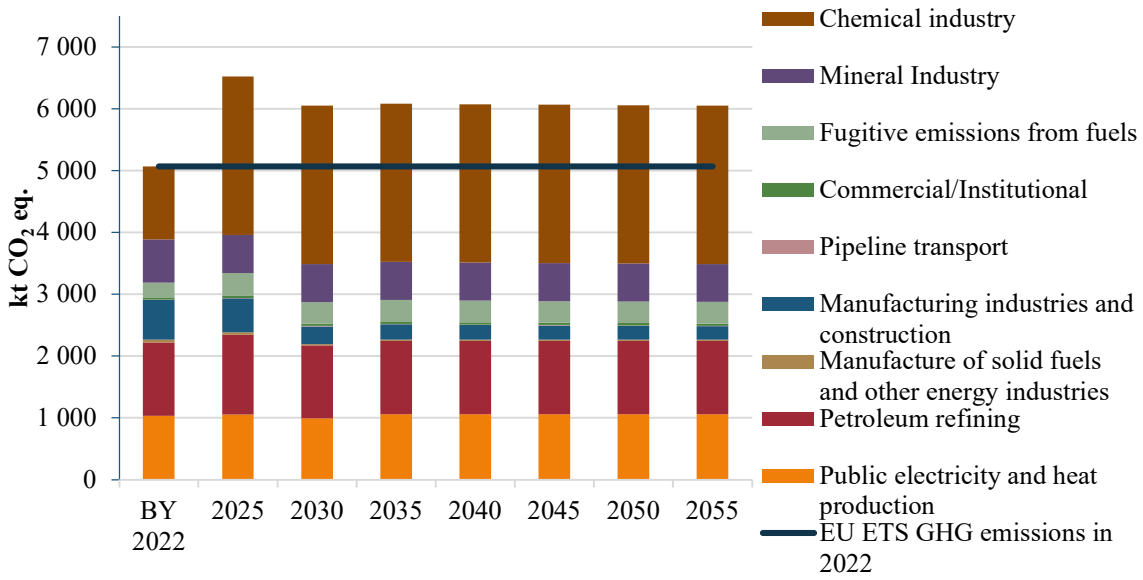

Figure 4-38. Projected GHG emissions in the EU ETS sectors (WEM Scenario), kt CO_2 eq.

In order to adjust the EU auctioned EUAs supply and stabilize the price of EUAs, the EP and the Council Decision concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC was adopted in May 2015, according to which the market stability reserve operates from 1st of January 2019 and other measures of reformed EU ETS were approved in 2023–2024, including those in "Fit for 55" package. These measures affect the EU and Lithuanian ETS operators.

The shortage of EUAs appears in the fourth phase of EUA market starting from 2021 and this shortage is predicted to continue until the end of period in 2030. The biggest shortage of EUAs will remain in sectors that are at the highest risk of carbon leakage: cement, ammonia production, oil refining, glass industry, where fossil fuels are still used.

Compared to WEM scenario, continued creation of green hydrogen production capacity would result in a decrease in GHG emissions in WAM scenario in chemical industry processes and petroleum refining sub-sectors. Continued decarbonisation of industry would reduce GHG emissions in manufacturing industries in WAM scenario. Finally, continued renovation of multi-apartment and non-residential buildings would result in a decrease of GHG emissions in public heat production in WAM scenario.

Table 4-45. *Projected GHG emissions in the EU ETS sector, kt CO_2 eq. (WEM scenario)*

Sector	BY 2022	2025	2030	2035	2040	2045	2050	2055
Public electricity and heat production	1,031.85	1,051.30	988.68	1,056.98	1,056.98	1,056.98	1,056.98	1,056.98
Petroleum refining	1,187.44	1,289.20	1,184.46	1,184.64	1,184.64	1,184.64	1,184.64	1,184.64
Manufacture of solid fuels and other energy industries	45.05	44.86	20.31	21.34	21.34	21.34	21.34	21.34
Manufacturing industries and construction	640.70	548.30	285.52	250.21	239.36	231.55	224.15	217.12
Pipeline transport	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21
Commercial/Institutional	37.88	37.88	37.88	37.88	37.88	37.88	37.88	37.88
Fugitive emissions from oil	236.64	365.64	348.90	348.90	348.90	348.90	348.90	348.90
Cement production	682.20	592.52	592.52	592.52	592.52	592.52	592.52	592.52

Mineral industry (other non-cement production)	18.07	21.74	22.04	22.31	22.58	22.58	22.58	22.58
Chemical industry	1,180.27	2,561.85	2,561.85	2,561.85	2,561.85	2,561.85	2,561.85	2,561.85
Total	5,066.30	6,519.50	6,048.36	6,082.83	6,072.25	6,064.44	6,057.04	6,050.02

Table 4-46. *Projected GHG emissions in the EU ETS sector, kt CO_2 eq. (WAM scenario)*

Sector	BY 2022	2025	2030	2035	2040	2045	2050	2055
Public electricity and heat production	1,031.85	1,037.11	771.92	771.92	771.92	771.92	771.92	771.92
Petroleum refining	1,187.44	1,289.26	1,179.12	1,179.12	1,179.12	1,179.12	1,179.12	1,179.12
Manufacture of solid fuels and other energy industries	45.06	44.88	18.33	18.33	18.33	18.33	18.33	18.33
Manufacturing industries and construction	640.70	513.88	114.70	119.88	117.89	120.61	123.37	126.53
Pipeline transport	4.44	0.26	6.21	6.21	6.21	6.21	6.21	6.21
Commercial/Institutional	37.88	37.88	37.88	37.88	37.88	37.88	37.88	37.88
Fugitive emissions from oil	236.64	365.64	NO	NO	NO	NO	NO	NO
Cement production	682.20	592.52	592.52	592.52	592.52	592.52	592.52	592.52
Mineral industry (other non-cement production)	18.07	21.74	22.04	22.31	22.58	22.58	22.58	22.58
Chemical industry	1,180.27	2,504.10	2,491.99	2,491.99	2,491.99	2,491.99	2,491.99	2,491.99
Total	5,066.30	6,413.20	5,234.69	5,240.14	5,238.43	5,241.15	5,243.91	5,247.07

The EU ETS GHG projection results show that GHG emissions in 2055 will increase by 19% and will be equal in total 6,050 kt CO_2 eq., if carbon prices remain stable (according to WEM scenario). The EU ETS GHG emissions sensitivity according to EUAs price changes was analysed in Chapter 4.7.

Sectors which do not fall under the scope of the EU ETS contribute the major proportion of GHG emissions in Lithuania. Those sectors are transport (except pipeline transport, international navigation and aviation and CO_2 from domestic aviation), non-ETS industry, agriculture, waste and non-ETS energy. The Effort Sharing legislation establishes binding targets of annual GHG emissions for Member States for the period 2021–2030. The EU Member States' national targets collectively delivered a reduction of around 16.3% in total the EU emissions from the sectors not covered by the EU ETS by 2020 and will deliver a reduction of 40% by 2030, compared with 2005 levels[24].

Projected emissions in the ESR sectors are presented in the figures and tables below.

[24] Effort Sharing Regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0857

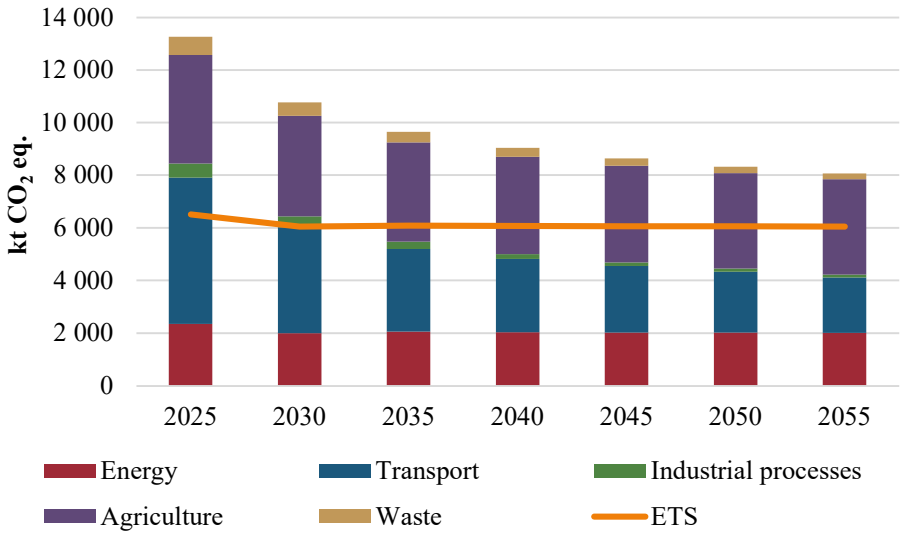

Figure 4-39. Projected GHG emissions in ESR sectors (without LULUCF) (WEM scenario), kt CO_2 eq.

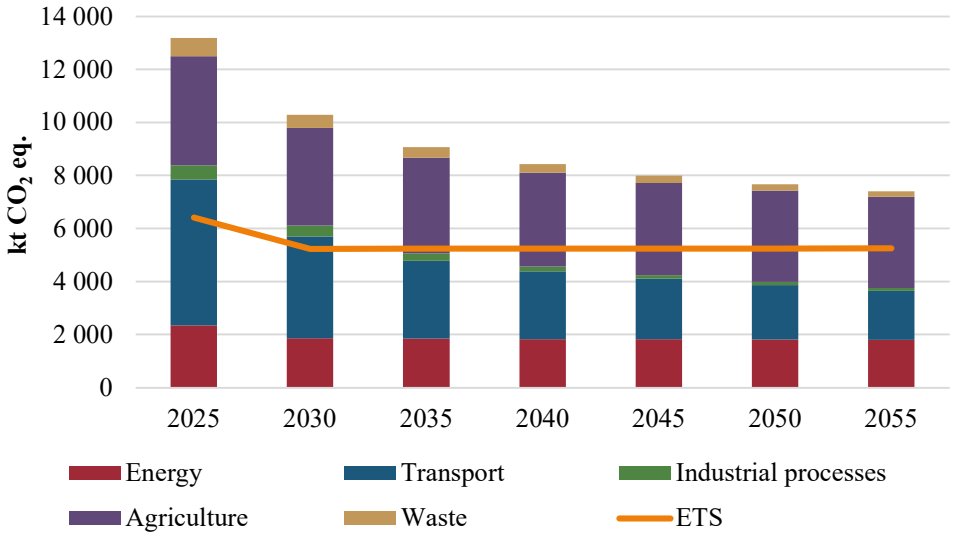

Figure 4-40. Projected GHG emissions in the ESR sectors (without LULUCF) (WAM scenario), kt CO_2 eq.

WEM and WAM scenarios differences result in decrease in GHG emissions by 4.4% in the ESR sectors in 2030. The main drivers behind this decrease are promoting the development of alternative fuels infrastructure and transport, promoting intermodal transport, investment support for implementing climate-friendly farming methods in livestock farms and more effective and precise use of inorganic N fertilizers in agriculture sector. These measures together with other smaller additional measures will determine lower total GHG emissions in the ESR sectors (10,289 kt CO_2 eq. in WAM scenario in 2030 and 7,405 kt CO_2 eq. in 2055).

Table 4-47. *Projected GHG emissions from the ESR sectors, kt CO_2 eq. (WEM scenario)*

Sector	2025	2030	2035	2040	2045	2050	2055
Energy	2,351	1,996	2,055	2,032	2,026	2,017	2,008
Transport	5,563	4,029	3,143	2,782	2,526	2,312	2,111
Industrial processes	530	415	274	185	136	121	101
Agriculture	4,124	3,815	3,776	3,705	3,666	3,625	3,625
Waste	693	510	405	335	285	247	219
Total	**13,260**	**10,765**	**9,652**	**9,038**	**8,638**	**8,322**	**8,064**

Table 4-48. *Projected GHG emissions from the ESR sectors, kt CO_2 eq. (WAM scenario)*

Sector	2025	2030	2035	2040	2045	2050	2055
Energy	2,347	1,856	1,850	1,827	1,820	1,811	1,803
Transport	5,506	3,839	2,935	2,556	2,283	2,052	1,851
Industrial processes	530	415	274	185	136	121	101
Agriculture	4,100	3,677	3,609	3,527	3,478	3,440	3,440
Waste	690	502	397	327	277	240	211
Total	**13,174**	**10,289**	**9,064**	**8,423**	**7,994**	**7,663**	**7,405**

These emissions are compared with the national GHG reduction target set by the European Parliament and of the Council under Regulation 2018/842 and adjusted by the Regulation (EU) 2023/857 for the ESR sectors in the period of 2021–2030[25]. Baseline 2005 value is set by the Commission Implementing Decision (EU) 2020/2126. According to projected GHG emissions included in the ESR sector, year 2021–2030 is seen as a challenge, because the GHG reduction target becomes negative, but Lithuania should also comply with its 2030 GHG reduction targets if additional PaMs are implemented. According to Regulation (EU) 2018/842 of the European Parliament and of the Council, Lithuania may use up to 6,500 kt CO_2 eq. of LULUCF credits to comply with its GHG emission reduction targets during 2021–2030. The estimated difference between AEAs and projected GHG emissions (WEM) is 1,874 kt CO_2 eq. in 2021, -130 kt CO_2 eq. in 2022 and -445 kt CO_2 eq. in 2030. Whereas the estimated difference between AEAs and projected GHG emissions (WAM) is 31 kt CO_2 eq. in 2030.

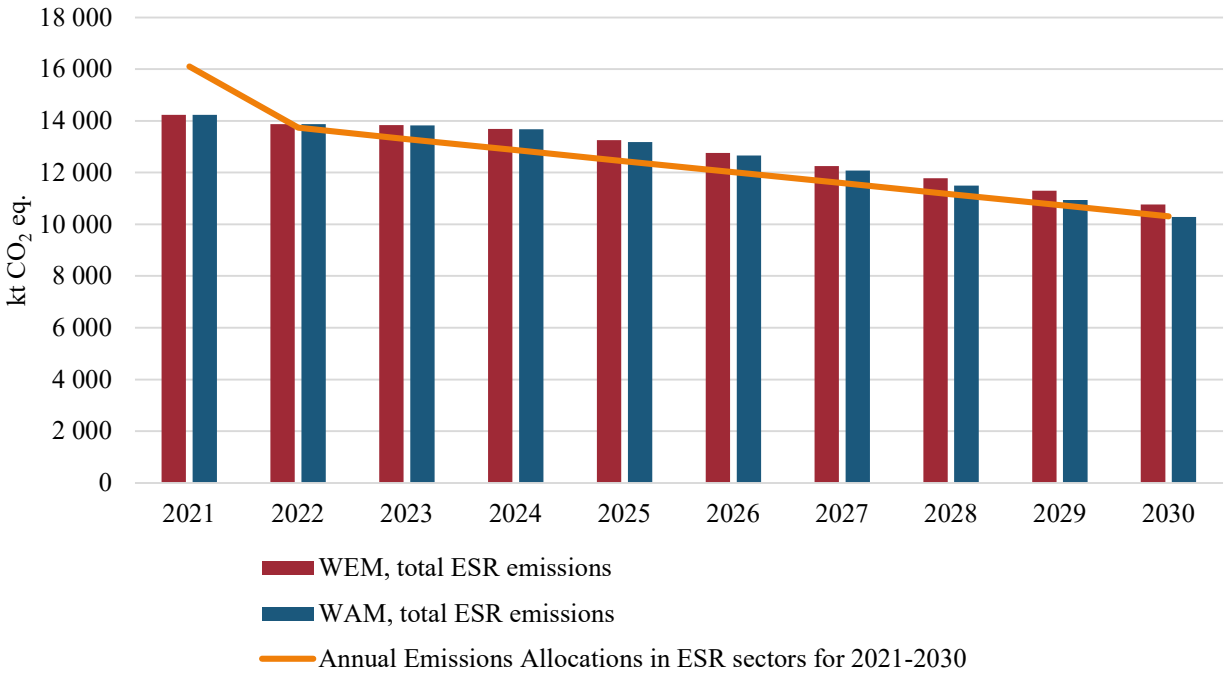

Figure 4-41. Comparison of WEM and WAM scenarios and draft AEAs for Lithuania in the ESR sectors for the period of 2021–2030

[25] https://ec.europa.eu/clima/policies/effort_en

5. DIFFERENCE BETWEEN PREVIOUSLY AND CURRENTLY REPORTED PROJECTIONS

The methodology and assumptions used for the preparation of the GHG Projections 2025 are different from that used for the preparation of the emission projections for the Projections 2023 report. The main differences in methodology and assumptions are as follow:

1. The base year in the Projections 2023 was 2019 while in the Projections 2025 it is 2022.
2. In the Projections 2023, GHG emission projections were estimated until 2050, whereas in the Projections 2025 emissions are estimated until 2055.
3. The projected activity data for the Projections 2025 was updated for all sectors as some of the historical data and base year have changed.
4. The revision of PAMs has been performed. Some additional measures introduced in the Projections 2023 were adopted, also new measures were introduced by the government.
5. Revised PaMs has led to the removal of a policy measure significantly affecting projections in the chemical industry from the industrial processes and product use sector.
6. Fuel consumption per kilometre in road transport was assumed to be by average 4% lower in 2030 than it was in 2021 for the whole vehicle fleet in the Projections 2025.

Table 5-1. *Changes in projections since Projections 2023 report (kt CO_2 eq.)*

	2025	2030	2035	2040	2045	2050
Energy without transport						
WEM 2025	5,688	4,862	4,955	4,922	4,907	4,891
WEM 2023	5,661	4,858	4,871	4,840	4,823	4,807
Difference	**27**	**3**	**84**	**82**	**84**	**84**
WAM 2025	5,636	3,978	3,977	3,952	3,948	3,942
WAM 2023	5,586	3,908	3,920	3,890	3,874	3,858
Difference	**50**	**69**	**56**	**62**	**74**	**84**
Transport						
WEM 2025	5,571	4,038	3,151	2,790	2,535	2,321
WEM 2023	5,560	4,020	3,139	2,780	2,525	2,312
Difference	**11**	**18**	**12**	**11**	**10**	**9**
WAM 2025	5,514	3,847	2,943	2,565	2,292	2,060
WAM 2023	5,512	3,847	2,949	2,572	2,299	2,069
Difference	**2**	**0**	**-5**	**-7**	**-8**	**-8**
Industrial processes and product use						
WEM 2025	3,345	3,218	3,077	2,988	2,939	2,924
WEM 2023	3,096	2,675	2,543	2,457	2,412	2,400
Difference	**249**	**543**	**534**	**531**	**527**	**524**
WAM 2025	3,345	3,218	3,077	2,988	2,939	2,924
WAM 2023	3,096	2,492	2,360	2,275	2,229	2,218
Difference	**249**	**726**	**717**	**713**	**710**	**707**
Agriculture						
WEM 2025	4,124	3,815	3,776	3,705	3,666	3,625
WEM 2023	4,169	3,866	3,825	3,751	3,711	3,667

Difference	**-45**	**-51**	**-49**	**-47**	**-45**	**-43**
WAM 2025	4,100	3,677	3,609	3,527	3,478	3,440
WAM 2023	4,081	3,700	3,661	3,587	3,547	3,503
Difference	**20**	**-23**	**-52**	**-60**	**-69**	**-64**
			LULUCF			
WEM 2025	-6,577	-7,459	-7,419	-7,175	-6,698	-5,393
WEM 2023	-6,576	-7,457	-7,199	-6,954	-6,479	-5,173
Difference	**-2**	**-2**	**-220**	**-221**	**-219**	**-220**
WAM 2025	-6,559	-7,594	-7,312	-6,987	-6,510	-5,173
WAM 2023	-6,559	-7,594	-7,312	-6,987	-6,510	-5,173
Difference	**0**	**0**	**0**	**0**	**0**	**0**
			Waste			
WEM 2025	693	510	405	335	285	247
WEM 2023	696	498	405	342	297	264
Difference	**-3**	**11**	**0**	**-7**	**-13**	**-17**
WAM 2025	690	502	397	327	277	240
WAM 2023	689	487	393	331	286	253
Difference	**2**	**15**	**3**	**-3**	**-9**	**-13**
			Total excluding LULUCF			
WEM 2025	19,420	16,441	15,363	14,739	14,332	14,008
WEM 2023	19,181	15,917	14,782	14,171	13,769	13,451
Difference	**239**	**525**	**581**	**569**	**563**	**557**
WAM 2025	19,286	15,222	14,003	13,360	12,934	12,606
WAM 2023	18,963	14,435	13,283	12,655	12,235	11,901
Difference	**322**	**787**	**719**	**705**	**699**	**705**

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